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EXPERIMENTAL STUDIES ON THE CURATIVE TREATMENT OF SURRA IN NATIVE HORSES IN THE PHILIPPINES, III.[1]

WITH A REPORT ON THE RESULTS OBTAINED IN BRITISH NORTH BORNEO

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The present contribution is the result of further studies on the chemotherapy of surra. From the literature reviewed it appears that Bubberman, Douwes, and van Bergen(4) were the first workers to investigate extensively the value of naganol in combination with either atoxyl or tartar emetic or both against equine surra in the Dutch East Indies. Fractional small and single large doses at various intervals were tried. At best the results obtained were noted with naganol and atoxyl in nonlethal but slightly toxic doses and administered simultaneously. Working with four naturally infected horses, Bakker(1) tried naganol and tartar emetic, and on two occasions atoxyl was employed in addition. Out of the four cases treated, two recovered and the rest developed paresis about two months after the course of the treatment. It was not stated, however, which of the two methods gave satisfactory results. In India, C. Kahan Singh,(7) with a view to reducing the expense involved in the treatment of surra, investigated the merit of naganol with tartar emetic. With 114 horses employed, he

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[1] Aided by a special research grant from the Board of Regents, University of the Philippines.

reported a recovery of about 80 per cent. The course of the treatment was spread over a period of one month, during which small fractional doses were given. Zijp(12) checked the work of his predecessors in the Netherlands Indies. He employed naganol and atoxyl on about 200 equines. Although the animals treated were not observed closely, the author noted fairly good results if the treatment was begun sufficiently early.

In the Eleventh International Congress held in London, Bubberman(3) reported that naganol with atoxyl administered simultaneously in large doses is attended with 60 per cent recovery in early cases. Hornby(6) obtained the best results in the treatment of equine surra with naganol alone or in combination with other drugs, as tartar emetic, antimosan, sulfarsenol, and others. Bakker(2) reinvestigated the value of naganol in combination with atoxyl, tartar emetic, and tryparsamide. Of the 12 horses treated, 6 were declared cured, the most effective combination being naganol and tartar emetic. In the Philippines, following closely the fractional method and using naganol in combination with tartar emetic and fuadin, Topacio(8) recorded 6 horses cured out of 11 experimentally infected and 29 out of 40 naturally infected. The course of the treatment was spread over a period of one month. Topacio attributed the high mortality in the experimental animals mainly to the highly virulent strain of trypanosome employed.

In view of the conflicting findings reported by various investigators on the merit of the combined treatment—that is, naganol with atoxyl on one hand, and naganol and tartar emetic on the other, an attempt was made to determine the value of each combination in nonlethal but slightly toxic doses. The results are given in the present paper.

MATERIALS AND METHODS

Animals used.—The same species of animals as those used in previously reported experiments were employed in this investigation.(9, 10) The bulk of the horses used in the field trials were in British North Borneo. The strain of trypanosome used in the controlled experiments was the same as that used in the two previous reports of this series.(9, 10) The strain met with in British North Borneo was identical in both morphology and biological behavior with the Philippine surra trypanosome. In fact, a consideration of other known factors, such as the proximity of the infected district to the Philippines and the occasional clandestine entrance of Philippine animals, and other circumstances, suggests strongly that the outbreak of surra in British North Borneo is of Philippine origin.(11)

Drugs used.—Besides naganol which had been previously used, atoxyl and the sodium salt of antimony tartrate were principally employed. The latter was selected because it is believed to be less toxic than the potassium salt. While atoxyl was secured through a local druggist, the sodium salt of antimony tartrate was imported in tablet form directly from Burrough Wellcome and Company, London, England.

Procedure.—The technic given in the initial report(9) was closely followed. In accordance with Paul Ehrlich's well-known dictum "Therapia sterilisans magna" in most of the experiments the drugs were administered in sublethal doses.[2]

EXPERIMENTS AND RESULTS

THE TREATMENT OF EQUINE SURRA WITH SIMULTANEOUS INJECTION OF NAGANOL AND ATOXYL

To determine the efficiency of the simultaneous intravenous injection of naganol and atoxyl against surra among Philippine horses, experiments 1 to 7 were carried out. A detailed description of each of the experiments follows.

Experiment 1.—Horse 75. Weight 175 kilograms.

March 18, 1936.—Admitted in the college hospital; microscopic examination showed the blood teeming with surra trypanosomes (++++). The animal had been noted to be with œdema in the pendant portion of the abdomen for some time. Other horses in the same stable had been observed to be similarly affected and died subsequently. The temperature was 39.8°C.; animal lethargic with pale mucous membrane. Animal inoculation positive; complement-fixation test positive (++++). The horse was given intravenously the initial treatment of 2.63 grams of atoxyl in 5 per cent concentration and 1.75 grams of naganol in 10 per cent sterile solution in distilled water.

March 19.—Blood negative. Temperature 38.7°C. Œdema of the prepuce, penis, abdomen, muzzle, and eyelids; horse decidedly depressed but appetite fair. Subcutaneous injection, 10 cc camphorated oil.

March 20.—Blood negative. Temperature 38°C.; condition same as above. Camphorated oil injection repeated.

March 21 to 26.—Blood negative. Condition slightly improved; œdema subsided somewhat but periproctitis developed.

March 27.—Blood negative. Atoxyl and naganol treatment repeated; dose of naganol reduced to 0.875 gram, concentration remaining the same as initial injection.

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[2] For a detailed description of the procedure, previous works may be consulted.(9-11)

March 28 to April 5.—Blood negative. Temperature normal.

April 6.—Blood negative. Treatment with trypanocidal drugs repeated; horse quite active; appetite good.

April 8.—Blood negative. Complement-fixation test positive (+ + + +); condition same as above.

April 9 to 12.—Blood negative. Temperature never above 38°C.

April 13.—Blood negative. Weakness in hind quarters, unable to get up without assistance, appetite fair.

April 14 to 20.—Blood negative; condition almost the same; appetite good.

April 21.—Blood negative. The animal was down, could not stand even when helped to its feet, hence a sling was adjusted; emaciation developing.

April 22.—Blood negative. Given intravenously 50 cc of a 10 per cent solution of calcium gluconate.

April 23.—Blood negative. Horse getting weaker; paresis of the hind quarters more marked; appetite good.

April 24.—Blood negative. Calcium gluconate treatment repeated; 20 cc of cerebrospinal fluid withdrawn and injected intraperitoneally to two white rats.

April 25 to May 1.—Blood negative. Inspite of good appetite weakness of the hind legs more marked; animal depressed and lethargic.

May 2.—Blood negative. Horse found in a recumbent position unable to stand even when assisted; 20 cc cerebrospinal fluid withdrawn by means of intrathecal puncture and injected immediately into two white rats.

May 4.—Horse dead, 27 days after last treatment.

May 7 to 20.—All four white rats negative by blood examination.

May 27.—Rats tested for susceptibility; all caught infective inoculation after 4 days and died subsequently.

Experiment 2.—Horse 76. Weight 124.5 kilograms.

May 18, 1936.—Infected subcutaneously with surra trypanosomes.

May 24.—Blood positive (+). Temperature 38.5 C.; complement-fixation test negative.

May 25.—Blood positive (+ +). Temperature 40.8°C.

May 26.—Blood positive (+ + +). Temperature 39.4°C. Animal slightly depressed with dyspnœa.

May 27.—Blood positive (+ + + +). Temperature 38.5°C.

May 28.—Blood positive (+ +). Temperature 39°C.; animal depressed.

May 29 and 30.—Blood negative. Temperature 38.4°C.

May 31.—Blood positive (+ + +). Temperature 39°C.

June 1.—Blood positive (+ + + +). Temperature 38.8°C.

June 2 and 3.—Blood positive (+). Temperature 39.1°C.; dyspnœa quite marked; œdema of the posterior extremities developed.

June 4, 5, and 6.—Blood positive (+ + + +). Temperature 1 to 2 degrees above normal.

June 7.—Blood positive (+ + +). Temperature 37.8°C.

June 8.—Blood negative. Temperature 38°C.; œdema of the prepuce noted for the first time. Animal reweighed (130 kilograms); 25 cc of cerebrospinal fluid obtained by intrathecal puncture and injected immediately intraperitoneally into two white rats each rat receiving 10 cc of the fluid. Balance tested for complement-fixing bodies, results negative. On the other hand, blood reacted positive (+ + + +) to the test. Horse given a simultaneous intravenous injection of atoxyl and naganol in doses of 1.95 and 1.30 grams, respectively, dissolved in enough sterile distilled water to make a concentration of 5 per cent of the former and 10 per cent of the latter drug.

June 9.—Blood negative. Temperature 37.6°C.; animal depressed; head held low; marked œdema of the prepuce, hind legs, and muzzle.

June 10 to 12.—Blood negative. Temperature 37.5°C. Condition unchanged.

June 13.—Blood negative. Temperature 37.9°C. Œdematous swelling of hind extremities, muzzle, and prepuce considerably subsided. Blood of the rats positive (+).

June 14.—Blood negative. Temperature 38.1°C. Treatment repeated. Dose of atoxyl increased to 2.6 grams, naganol reduced to 0.65 grams.

June 15.—Blood negative. Temperature 38.2°C. Condition slightly improved.

June 16 and 17.—Blood negative. Temperature normal.

June 18.—Blood negative. Temperature 38°C. Perirectal eruption noted. Positive rat died, the other noted positive for first time on examination of tail blood.

June 19.—Blood negative. Temperature 36.5°C. Appetite good; horse quite active; œdematous swelling completely disappeared.

June 20.—Blood negative. Temperature 37.8° C. Third course of treatment given, observing same doses as second. Second positive rat died.

June 21 to 31.—Blood negative. Temperature 38.3°C. Condition fair; appetite good.

July 1.—Blood negative. Temperature 38.4°C. Appetite good but emaciation beginning to appear.

July 2 to 31.—Blood negative. Temperature 37.9° C. Condition fair.

August 1.—Blood negative. Slight dyspnœa noted; temperature 37.8° C.; appetite good.

August 2 to 11.—Blood negative. Temperature normal.

August 12.—Blood negative. Temperature 37.8°C. Complement-fixation test (+ + +) in one tube and (+ +) in the other.

August 14.—Blood negative. Temperature 37.6°C. Weakness of hind legs; animal unable to get up without assistance.

August 25 to 18.—Blood negative. Temperature normal; paresis of hind legs marked; appetite good.

August 19.—Blood negative. Temperature 36.7° C. Animal down, unable to gain its feet even when assisted. Intrathecal puncture performed but difficulty was encountered in withdrawing cerebrospinal fluid. Only about 10 cc mixed with blood was obtained and injected into three white mice. The horse died not long after the operation.

August 26.—Blood of one mouse positive (+); other two negative.

August 30.—Positive mouse dead; one of the two negative mice became positive (+ + +) and died the day following. The last mouse did not developed surra during an observation period of 30 days after inoculation with cerebrospinal fluid. At the end of the period, it was tested for susceptibility; it caught the disease 7 days afterwards and died 5 days later.

Experiment 3.—Horse 77. Weight 138 kilograms.

October 21, 1936.—Infected intracutaneosuly with surra blood.

October 25.—Blood positive (+). Temperature 38.2°C.

October 27.—Blood positive (+ + +). Temperature 40.7° C. Animal depressed.

October 28.—Blood positive (+ +). Temperature 38.9° C.

October 29.—Blood positive (+ + +). Temperature normal. Animal depressed.

October 30.—Blood positive (+ + + +). Temperature 39.9° C.

October 31.—Blood positive (+ + + +). Temperature 38.8°C. Condition same as October 29.

November 1.—Blood positive (+). Temperature normal. Animal depressed with slight œdema of lower portion of hind legs.

November 2.—Blood positive (+ +).

November 3.—Blood positive (+ + + +). Temperature 39.8°C. Animal dyspnœic; appetite good.

November 4.—Blood positive (+ + + +). Temperature normal. Condition same as above.

November 5.—Blood positive (+ +), watery. Temperature 39.5° C.

November 6.—Blood positive (+ + +). Temperature normal. Animal depressed but with good appetite.

November 7.—Blood positive (+). Temperature 1.4°C. above normal. Slight œdema of ventral portion of abdomen noted for first time.

November 8.—Blood positive (+). Temperature returned to normal. Thirty cc of cerebrospinal fluid obtained and injected into two white rats, each, receiving approximately 15 cc. Microscopic examination of the centrifuged cerebrospinal fluid showed surra trypanosomes.

November 9.—Blood positive (+ +). Temperature 38.6°C. Animal reweighed (125 kilograms). Injected simultaneously with 2.5 grams each of atoxyl and naganol dissolved in sufficient sterile distilled water to make 5 and 10 per cent concentration, respectively.

November 10.—Blood negative. Temperature 39.8° C. Appetite good; œdematous swelling of the muzzle noted; visible mucous membrane icteric.

November 11.—Blood negative. Temperature returned to normal. Condition same as above.

November 12.—Blood negative. Temperature normal. Animal depressed; appetite good; perirectal eruption developed, which disappeared in the course of 15 days; complement-fixation test positive (+) in one tube, negative in the other.

November 13.—Blood negative. Animal weaker than yesterday. Both rats positive (+ + + +).

November 14.—Blood negative. Temperature normal. Condition same as above.

November 15 and 16.—Blood negative. Condition slightly improved; appetite good. Rats positive (+ + + +).

November 17.—Blood negative. White rats dead.

November 18 and 19.—Blood negative. Condition continued to improve.

November 20.—Blood negative. Complement-fixation test (++) in the first tube, (+) in the second, (±) in the third.

November 21 to 30.—Blood negative. Condition greatly improved.

December 1 to 21.—Blood negative. Temperature never above normal.

January 1 to 4, 1937.—Blood negative. General condition fair.

January 5.—Blood negative. Complement-fixation test negative in three tubes.

January 6 to February 14.—Blood negative. General condition fair.

February 15.—Blood negative. Inspite of good appetite the animal did not put on much weight. Complement-fixation test carried (±).

April 21 to May 31.—Blood negative. Complement-fixation test performed May 26 showed (+ +) in one tube and (+) in the other.

June 1.—Blood negative. Complement-fixation test (++) in the first tube and (+++) in the second.

June 2 to 22.—Blood negative. Complement-fixation test performed June 11 showed the same result as that performed June 1.

June 22.—Blood negative. Animal weighed (109 kilograms).

June 23 to September 1.—Blood negative. Inspite of fair appetite a progressive emaciation noted.

September 2.—Blood negative. Animal down, unable to get up without assistance.

September 3.—Blood negative. Horse depressed, greatly emaciated, weak, and in recumbent position.

September 4.—Blood negative. Animal unable to remain standing even when placed in sling. 20 cc of cerebrospinal fluid withdrawn and injected intraperitoneally in two white rats.

September 5.—Animal found dead, 294 days after treatment.

September 10.—White rats negative to microscopic examination of tail blood. Rats observed up to October 4 when susceptibility test was performed. Both rats went down with the disease 4 days later and died subsequently.

Experiment 4.—Horse 78. Weight 117 kilograms.

November 18, 1936.—Blood negative. Temperature 37.5° C. Inoculated intracutaneously with surra blood.

November 28.—Blood positive (+ +). Temperature 39.3°C.

November 30.—Blood positive (++++). Temperature 38.7°C. Appetite good.

December 2.—Blood positive (+). Temperature 37°C.

December 4.—Blood negative. Temperature normal.

December 5.—Blood positive (+). Animal slightly depressed.

December 6.—Blood positive (+ + +). Temperature 39.4°C. Slight dyspnœa noted; appetite good.

December 7.—Blood positive (+ + + +). Temperature 40.4° C. Horse depressed with head held low; appetite good.

December 8.—Blood positive (+). Temperature 39.1° C. Condition about same as above, with œdema of hind legs.

December 9.—Blood positive (+). Temperature 39.7°C. Animal reweighed (105 kilograms). 20 cc cerebrospinal fluid removed by intrathecal puncture and immediately injected into white rats.

December 10.—Blood negative. Temperature 39.3° C. Appetite fair; slight weakness of hind legs. Treated with a simultaneous injection of naganol and atoxyl in doses of 2.1 grams each dissolved in enough sterile distilled water to make up strength of solution as in the foregoing experiments.

December 11.—Blood negative. Temperature 37.8°C. Animal depressed, head held low, œdema of muzzle, eyelids, ears, limbs, and ventral portion of abdomen; appetite fair.

December 12.—Blood negative. Temperature 37.8° C. Appetite poor; œdematous swelling more marked.

December 13.—Blood negative. Temperature 38.3° C. Condition almost the same as above.

December 14—Blood negative. Temperature 38° C. Appetite fair; no visible improvement noted; horse distinctly depressed.

December 15.—Blood negative. Animal down in the morning; however, when helped to its feet, maintained a standing position; markedly dull with rapid respiration; anus relaxed. In the afternoon the horse was down again; decidedly weak in the hind quarters; given 10 cc camphorated oil subcutaneously.

December 16.—Horse found dead early in the morning.

Experiment 5.—Horse 79. Weight 102 kilograms.

December 17, 1936.—Infected intracutaneously with surra trypanosome.

December 24.—Blood positive (+). Temperature 37.8° C.

December 25.—Blood positive (+ + +). Temperature 38° C.

December 26.—Blood positive (+ + +). Temperature 39° C. Animal slightly depressed; appetite good.

December 27.—Blood positive (+ + + +). Temperature returned to normal. Condition same as yesterday.

December 28 and 29.—Blood positive (+ + + +). Temperature 1° C. above normal. Reweighed (92 kilograms).

December 30.—Blood positive (+ +). Temperature 37.2° C. Horse down in the morning but when led to its feet animal stood without assistance; slight weakness of hind legs noted; appetite good. Treated with atoxyl and naganol in doses of 1.80 grams each of same strength of solution as above. In the afternoon horse given one cc of fluid extract of nux vomica in water *per os*. Animal quite weak.

December 31.—Blood negative. Temperature 37.4°C. General condition about same as yesterday, appetite good. In the afternoon given fluid extract of digitalis and nux vomica one cc each in water *per os*.

January 1, 1937.—Blood negative. Temperature 37.1°C. Digitalis and nux vomica treatment repeated. Mucous membrane slightly icteric; animal quite weak.

January 2.—Blood negative. Temperature 37.4°C. Condition unchanged, same treatment as above.

January 3.—Blood negative. Animal sinking gradually; emaciation quite marked.

January 21.—Blood negative. Temperature 37.2° C. Marked weakness of hind legs noted. Complement-fixation test (+ + +) in one tube and (+ +) in the other.

January 22 to 30.—Blood negative. Animal greatly emaciated with weakness of hind quarters.

January 31.—Blood negative. Temperature subnormal. Ten cc of cerebrospinal fluid obtained and injected immediately into two white rats.

February 1.—Horse found dead.

February 6.—White rats remained negative. Subsequent blood examinations failed to show infection. Hence, after 20 days a test for susceptibility was performed. Both rats caught infection and died subsequently.

Experiment 6.—Horse 80. Weight 161 kilograms.

January 5, 1937.—Infected subcutaneously with surra blood.

January 11.—Blood positive (+). Temperature 37.4° C.

January 12.—Blood positive (++). Temperature 37.4° C.

January 13 to 15.—Blood positive (+ + + +). Temperature 0.4 to 1.2° C. above normal. Animal slightly dull; appetite good.

January 16 and 17.—Blood positive (+ + +). Temperature returned to normal. Animal dyspnœic, with slight œdema of hind legs.

January 18 and 19.—Blood positive (+ + + +). Temperature 38.1° C. and 39° C., respectively. Condition about same as above; appetite fair.

January 20.—Blood positive (+ +). Temperature 37.4° C.

January 21 and 22.—Blood positive (+ + +). Temperature 38.5° C. and 36.7°C., respectively.

January 23.—Blood positive (+ + + +). Temperature 38.3° C.

January 24.—Blood positive (+ +). Temperature 38.3° C. Animal reweighed (160 kilograms).

January 25.—Blood positive (+ + + +). Temperature 38.9° C.

January 26 and 27.—Blood positive (+ + +). Temperature 38.9° C. and 38.5° C., respectively. Œdema of prepuce noted for first time; appetite good.

January 28.—Blood positive (+ + + +). Temperature returned to normal. Animal dull; œdema extended to penis; anus relaxed; appetite good. Treated in the morning with 3.2 grams of each of atoxyl and naganol in 5 and 10 per cent sterile water solution, respectively, and injected intravenously. In the afternoon the horse was given hypodermically ⅗ grain strychnine sulphate in 2 cc sterile distilled water.

January 29.—Blood negative. Temperature 38.3° C. Animal depressed, with head held low. Face swollen with œdema of muzzle. Œdematous swelling of external genital organs and limbs decidedly more severe than previously; appetite remaining good. Strychnine injection repeated.

January 30 to February 14.—Blood negative. Temperature range between 35.7 and 37.7°C. Œdema previously noted in various parts of body partially subsided.

February 15.—Blood negative. Temperature 36.8° C. Appetite good; complement-fixation test negative in two tubes.

February 16 to March 1.—Blood negative. No decided improvement inspite of good appetite.

March 2.—Blood negative. Temperature 36.3° C. Complement-fixation test repeated with negative result.

March 3 to 16.—Blood negative. Condition about the same.

March 17.—Blood negative. Complement-fixation test negative in two tubes.

March 18 to May 3.—Blood negative. Temperature variable, ranging between 36.1 and 38.1° C. Condition fair.

May 4.—Blood negative. Temperature 39°C.

May 5.—Blood positive (+). Relapsed since treatment was given 108 days ago. Temperature 40°C. Infected two white mice with the blood.

May 6.—Blood negative. Temperature returned to normal. Reweighed (142 kilograms). Condition poor.

May 7.—Blood positive (+). Temperature 36.9°C.

May 8.—Blood positive (+). Temperature 37.2° C. Mice positive (+ + +), died after three days. Since the recovered trypanosomes showed no indication of lowered virulence, the horse was killed.

Experiment 7.—Horse 81. Weight 128 kilograms.

April 22, 1937.—Infected subcutaneously with surra trypanosomes.

April 30.—Blood positive (+). Temperature 39.8°C. Appetite good.

May 1.—Blood positive (+ +). Temperature 40.3° C. Condition good; appetite fair.

May 2.—Blood positive (+ +). Temperature 38.3° C. Beyond a slight dullness condition about same as above.

May 3.—Blood positive (+ + + +). Temperature 40.5°C.

May 4.—Blood positive (+ + + +). Temperature 38.5°C.

May 5.—Blood negative. Temperature 38.7°C.

May 6.—Blood positive (+). Temperature 38.8°C.

May 7.—Blood positive (+ + +). Temperature 38.8° C.

May 8.—Blood positive (+ + +). Temperature 38.4° C.

May 9 and 10.—Blood positive (+ +). Temperature 39.8°C. and 39.4°C.

May 11.—Blood positive (+). Temperature 38.6° C.

May 12.—Blood positive (+ +). Temperature 40.2°C.

May 13.—Blood positive (+ + +). Temperature 39.6°C. Blood obtained for complement-fixation test; result plus or minus (±) in each test tube; blood watery.

May 14.—Blood positive (+ + + +). Temperature 39°C. Animal reweighed (110 kilograms). Treated intraveneously with atoxyl and naganol in doses of 2.2 grams each, in same concentration as in foregoing experiments.

May 15.—Blood negative. Temperature 39.3°C. Animal depressed, weak, with œdema of face, muzzle, and legs as noted in other experimental animals.

May 16.—Blood negative. Temperature 39.4°C. Appetite good; condition unchanged.

May 17.—Blood negative. Temperature 39° C. Condition unchanged.

May 18.—Blood negative. Temperature 38.7°C.

May 19 to 25.—Blood negative. Temperature returned to normal; general condition on the decline.

May 26.—Blood negative. Temperature 35.3°C. Weakness of hind legs; perirectal eruption developed. Complement-fixation test (+) in two tubes.

May 27.—Blood negative. Temperature 38.3°C.

May 28.—Blood negative. Temperature 36.5°C. Animal down but when helped regained its legs; weakness of hind quarters quite marked. Given 2 cc fluid extract of nux vomica in water *per os.*

May 29.—Blood negative. Temperature 37°C. Early in the morning, horse noted lying down. Able to stand up if assisted. Nux vomica treatment repeated.

May 30 and 31.—Blood negative. Temperature normal. Treatment with nux vomica repeated.

June 1.—Blood negative. Temperature 38.2°C. Treatment with nux vomica with 10 cc of aromatic spirit of ammonia in water given *per os*. No improvement in condition. Results of complement-fixation test same as on two previous occasions.

June 2 to 7.—Blood negative. Temperature normal. Treatment with nux vomica and aromatic spirit of ammonia continued. Inspite of good appetite, emaciation progressing.

June 8 to 10.—Blood negative; condition unchanged.

June 11.—Blood negative. Temperature 37.2°C. 50 cc of cerebrospinal fluid obtained by means of intrathecal puncture. 40 cc was injected intraperitoneally into 4 white mice, each mouse receiving 10 cc. Balance subjected to complement-fixation test, result (+) in one tube and (+ +) in the other.

June 15.—Animal died greatly emaciated; blood of mice negative to tail-blood examination.

June 21 to 30.—Blood of mice still negative.

July 1.—Susceptiblity test performed on mice; all caught the disease 4 days after infection and died later.

THE TREATMENT OF EQUINE SURRA WITH SIMULTANEOUS INJECTION OF NAGANOL AND SODIUM ANTIMONY TARTRATE

Experiments 8 to 16 were designed to test the value of the combined trypanocidal action of naganol and sodium antimony tartrate in experimental and natural surra among native horses.

Experiment 8.—Horse 82. Weight 154.5 kilograms.

July 21, 1937.—Infected subcutaneously with surra blood.

July 29.—Blood positive (+). Temperature 38.8°C.

July 30 to August 4.—Blood positive (+ +). Temperature ranging between 38°C. and 40°C. Animal slightly dull.

August 5 to 7.—Blood negative. Temperature never above normal; slight emaciation developing; appetite good; hind quarter slightly wobbly.

August 8.—Blood positive (+ + +). Temperature 39.4°C. Condition unchanged.

August 9.—Blood positive (+ + + +). Temperature 38.7°C.

August 10.—Blood positive (+ + +). Temperature 38.8°C.

August 11.—Blood positive (+ +). Temperature 38.8°C.

August 12.—Blood positive (+). Temperature 38.3°C. Animal reweighed (138 kilograms).

August 13.—Blood positive (+ + + +). Temperature 39°C. Inspite of fair appetite animal getting more depressed and weaker.

August 14.—Blood positive (+ + + +). Temperature unchanged.

August 15.—Blood positive (+ + + +). Temperature 37.7°C. Reweighed (138 kilograms). Given intravenously 1.43 grams of sodium antimony tartrate in 1 per cent concentration and 2.76 grams naganol in 10 per cent solution. During injection of former the horse collapsed. When sufficiently recovered, the naganol was administered intravenously.

August 16.—Animal found dead in the morning.

Experiment 9.—Horse 83. Weight 111.8 kilograms.

August 15, 1937.—Inoculated with surra blood from horse 82.

August 22.—Blood positive (+). Temperature 39.2°C.

August 23.—Blood positive (+). Temperature 41°C.

August 24.—Blood positive (+). Temperature 39°C.

August 25 and 26.—Blood positive (+ +). Temperature 39.2°C. and 39.7°C., respectively. Appetite good.

August 27.—Blood positive (+ + +). Temperature 39.3°C. Animal slightly depressed.

August 28.—Blood positive (+ +). Temperature 38°C. Horse dull and slightly weak, with certain degree of emaciation; appetite fair.

August 29.—Blood positive (+), watery. Temperature 38.2°C.; condition same as above.

August 30.—Blood positive (+ +). Temperature 38.2°C.

August 31.—Blood positive (+ +). Temperature 39.9°C.

September 1.—Blood positive (+ + +). Temperature 40.9°C.

September 2.—Blood positive (+ +). Temperature 39.6°C.

September 3.—Blood negative. Temperature 37.6°C.

September 4.—Blood positive (+). Temperature 39.5°C.

September 5.—Blood positive (+ +). Temperature 39.4°C.

September 6.—Blood positive (+ + + +). Temperature 39.4°C. Reweighed (87 kilograms). Treated with 1.74 grams of naganol and 0.65 grams of sodium-antimony tartrate. During the naganol injection the respiration was 30, but when the antimony was given it rose to 60 per minute.

September 7.—Blood negative. Temperature 40.2°C.; respiration normal.

September 8.—Blood negative. Temperature 38.7°C. Appetite poor; animal weak and decidedly depressed.

September 9.—Blood negative. Temperature 38.7°C. Œdema of the hind legs; streaks of blood noted in the anal region.

September 10.—Animal found dead the following morning.

Experiment 10.—Horse 84. Weight 162 kilograms.

August 15, 1937.—Infected with surra blood from animal 83.

August 22.—Blood negative. Temperature 40.5°C. Animal slightly dull but appetite good.

August 23.—Blood positive (+). Temperature 39°C.

August 24.—Blood positive (+). Temperature 38.3°C.

August 25.—Blood positive (+ +). Temperature 40.6°C.

August 26 and 27.—Blood negative. Temperature normal.

August 28.—Blood positive (+ +). Temperature same as above.

August 29.—Blood positive (+ +). Temperature 38.9°C.

August 30.—Blood positive (+). Temperature 39.1°C.

August 31.—Blood negative. Temperature 37.1°C.

September 1.—Blood positive (+ +). Temperature 40.6°C.

September 2.—Blood positive (+). Temperature 40.9°C.

September 3.—Blood negative. Temperature 41°C.

September 4.—Blood negative. Temperature 40.4°C.

September 5.—Blood negative. Temperature 39°C. Animal reweighed (174 kilograms). Treated with 2.58 grams of naganol and 1.3 grams of sodium antimony tartrate.

September 6.—Blood negative. Temperature 38°C. Animal decidedly depressed with œdema of pendant portion of body.

September 7.—Blood negative. Temperature 37.5°C. Condition same as above.

September 8 to 17.—Blood positive. Temperature never above 38.1°C.; condition slightly improved.

September 18.—Blood negative. Temperature 37.8°C. Animal improving, treatment with naganol-sodium antimony tartrate repeated.

September 19.—Blood negative. Temperature 38.1°C.

September 22.—Horse found dead.

Experiment 11.—Horse 85. Weight 163 kilograms; a greatly emaciated animal.

November 18, 1937.—Injected subcutaneously with 10 cc of blood from a surra carabao.

November 24.—Blood positive (+). Temperature 39.1°C.

November 25.—Blood positive (+ +). Temperature 38.8°C.

November 26.—Blood positive (+ + +). Temperature 39° C.

November 27.—Blood positive (+ + +). Temperature 38.9°C.

November 28.—Blood positive (+ + + +). Temperature 39.5°C.

November 29.—Blood positive (+ +). Temperature 38°C.

November 30.—Blood positive (+). Temperature 39°C. Appetite fair; emaciation more marked with bilateral nasal discharge.

December 1.—Blood positive (+). Temperature 38.9°C.

December 2.—Blood positive (+). Temperature 38.2°C. Appetite poor; animal decidedly weak.

December 3.—Animal found dead; no autopsy performed.

Experiment 12.—Horse 86. Weight 140 kilograms.

October 11, 1937.—Infected with surra blood from a rat.

October 17.—Blood positive (+). Temperature 37.6°C.

October 18.—Blood positive (+ +). Temperature 38.5°C.

October 19.—Blood positive (+ + + +). Temperature 38.6° C.

October 20 and 21.—Blood positive (+ + + +). Temperature 38.7°C. and 39.2° C.

October 22.—Blood positive (+ + +). Temperature 38.6°C.

October 23.—Blood negative. Temperature 37.2°C.

October 24.—Blood positive (+). Temperature 37.8°C.

October 25.—Blood positive (+). Temperature 37.2°C.

October 26.—Blood positive (+ +). Temperature 38.7°C.

October 27.—Blood positive (+). Temperature 37.4°C.

October 28.—Blood positive (+ + + +). Temperature 39.2°C.

October 29.—Blood positive (+). Temperature 37.9°C.

October 30.—Blood positive (+ +). Temperature 37.9°C. Animal reweighed (134 kilograms). Treated with 2 grams naganol in 10 per cent solution in the morning, and in the afternoon the animal was injected with 1 gram of sodium-antimony tartrate in 1 per cent concentration.

October 31.—Blood negative. Temperature 38.9°C.

November 1.—Blood negative. Temperature 40°C.

November 2.—Blood negative. Temperature 38.9°C.

November 3 to December 7.—Blood negative. Temperature ranging between 36.5°C. and 38.4°C.

December 8.—Blood negative. Temperature 39.9°C. Complement-fixation test negative in one tube and (+) in the other.

December 9 to 30.—Blood negative. Temperature never over 38.4°C.

December 31.—Blood negative. Temperature 38°C. Complement-fixation test (+ +) in first (+ + +) in second tube.

January 3 to February 1, 1938.—Blood negative. Temperature normal. Animal decidedly improved.

February 2.—Blood negative. Temperature 37.2°C. Complement-fixation test negative in two tubes.

February 3.—Blood negative. Temperature 37.5°C.

February 7.—Blood negative. Temperature 37°C. Due to unknown cause the horse accidentally fell into the manger. When released the animal attempted to rise on its feet but failed. Hence it was supported in a standing position with a sling. Animal treated with 0.1 grain of strychnine sulphate hypodermically.

February 8.—Blood negative. Temperature 38°C. Bruises on the back, neck, and legs treated with a liberal application of white lotion. Injection of strychnine sulphate repeated.

February 9.—Blood negative. Temperature 37.6°C. Bruises dressed same as above. Hypodermic injection of strychnine sulphate given.

February 10 to 16.—Blood negative. Temperature never above normal. Bruises treated as usual. Strychnine sulphate treatment given daily; animal much improved.

February 17 to 27.—Blood negative. Temperature never above 37.8°C. The animal kept continuously in sling. Skin lesions beginning to suppurate, treatment changed to a mixture of pine tar, glycerine, and phenol.

February 28.—Blood negative. Temperature 37.8°C. The skin lesions dressed as above. Given under the skin, 1,500 units of tetanus antitoxin.

March 1 to 8.—Blood negative. Temperature normal. Horse taken daily for a short walk. When in the stall the animal was in sling; skin lesion treated as usual. Condition decidedly improved.

March 9.—Blood negative. Temperature 37.5°C. Lesions on the skin treated in the same manner as above. Complement-fixation test negative in both tubes.

March 10 to 15.—Blood negative. Temperature ranging between 36.9°C. and 37.7°C.

March 16.—Blood negative. Temperature 38°C. Sling removed; animal placed in pasture for an hour; skin lesions almost healed.

March 17 to April 5.—Blood negative. Temperature never above 38.4°C.; animal gaining in weight.

April 6.—Blood negative. Complement-fixation test negative. Skin lesions completely healed.

April 7 to July 5.—Blood negative. Temperature normal. Animal gained considerable weight (150 kilograms).

July 6, 1938, to April 30, 1940.—Animal in excellent condition; weight 160 kilograms. Repeated animal inoculations of both cerebrospinal fluid and blood never showed surra trypanosomes.

Experiment 13.—Horse 87. Weight 145 kilograms.

January 29, 1938.—Infected subcutaneously with surra organisms obtained from a guinea pig.

February 5.—Blood positive (+ +). Temperature 40°C.

February 7.—Blood positive (+ + +). Temperature 39.4°C.

February 8.—Blood positive (+ + + +). Temperature 40.5°C. Animal slightly dull with accelerated respiration.

February 9.—Blood positive (++). Temperature 38.3°C. Dullness, but augmented respiration subsided.

February 10.—Blood positive (+). Temperature 38.5°C.

February 11.—Blood positive (+ +). Temperature 40°C.

February 12.—Blood positive (+ + +). Temperature 38.2°C.

February 14.—Blood positive (+). Temperature 37.8°C.

February 15.—Blood negative. Temperature 38.4°C.

February 16.—Blood positive (+). Temperature 38.6°C.

February 17.—Blood positive (+ + + +). Temperature 40.2°C. Animal slightly depressed with a serous bilateral nasal discharge.

February 18.—Blood positive (+ + + +). Temperature 39.2°C. Animal reweighed (141 kilograms). One male white rat inoculated with cerebrospinal fluid obtained by means of suboccipital puncture. Naganol treatment instituted in the afternoon, 2.12 grams dissolved in 40 cc sterile distilled water.

February 19.—Blood negative. Temperature same as above. Œdema formed in various parts of body, as in the muzzle, scrotum, and preputial region; animal quite depressed. In the afternoon 1.3 grams of sodium-antimony tartrate in 1 per cent solution injected intravenously.

February 20.—Sunday, no treatment given.

February 21.—Blood negative. Anal region moist and penis protruding. Œdematous swelling observed soon after naganol therapy still persisting. Inoculated rat still negative on microscopic examination of tail blood.

February 22 to 24.—Blood negative. Temperature normal. Condition unchanged.

February 25.—Blood negative. Temperature 37.2° C. Œdematous swelling subsiding; appetite good.

February 26.—Blood negative. Temperature 37.3° C. Animal quite weak but appetite good.

February 28.—Blood negative. Temperature 38° C.

March 1.—Inoculated white rat noted for the first time positive and died 3 days later.

March 2 to 28.—Blood negative. Temperature never above 38.4° C. Œdema subsided completely, even penis retracted into its sheath; animal starting to pick up. Perirectal eruption almost healed.

April 6.—Blood negative. Complement-fixation test negative in one tube but (±) in the other.

April 7 to June 21.—Blood negative. Animal noticeably improved.

June 22.—Blood negative. Complement-fixation test negative in two test tubes.

June 23 to December 31.—Animal turned into the pasture. Complement-fixation test performed in three instances all negative. Repeated laboratory animal inoculations with blood likewise negative.

January 1 to November 30, 1939.—Animal never showed sign of surra; repeated inoculation into laboratory animals of both blood and cerebrospinal fluid negative; horse reweighed (220 kilograms).

December 20, 1939.—Killed for anatomy specimen.

Experiment 14.—Horse 88. Weight 245 kilograms.

March 12, 1938.—Animal admitted to the college hospital suffering from surra. Except for slight degree of emaciation, condition fair. Blood on examination teeming with trypanosomes (+ + + +). Temperature 39° C. Given intravenously 2 grams of naganol in 10 per cent sterile distilled water. Four hours later, given 1.30 grams of sodium-antimony tartrate in 1 per cent concentration.

March 14.—Blood negative. Temperature 37.5° C.; œdema of the scrotum, prepuce, and penis noted. In fact the penis remained out of the sheath all the time (paraphimosis); appetite good.

March 15.—Blood negative. Temperature 38.2° C.; condition the same as above.

March 16.—Blood negative. Temperature 37.6° C.

March 18.—Blood negative. Temperature 38.4° C. Paraphimosis considerably improved, penis partially retracted into the sheath.

March 19.—Blood negative. Temperature 37.6° C. Œdematous swelling together with paraphimosis completely subsided. Animal decidedly improved.

March 23.—Blood negative. Temperature 38.2° C. Perirectal eruption noted which behaved in much the same manner as in previous experiments.

March 23 to April 5.—Blood negative. Temperature never above 38.4° C.

April 6.—Blood negative. Temperature 37.8° C. Complement-fixation test (+ + +) in the first and (+ + + +) in the second tube.

April 6 to 28.—Blood negative. Animal slightly emaciated.

May 1.—Blood negative. Temperature 38° C; paresis of hind legs noted for first time.

May 2.—Blood negative. Temperature 37.6° C. Appetite good. Due to paretic condition of hind quarters horse unable to remain standing, even when assistance was given.

May 3.—Animal killed *in extremis.*

Experiment 15.—Horse 89. Weight 146 kilograms.

July 2, 1938.—Admitted at the clinic of the College of Veterinary Science with the complaint of irregular appetite. Blood examination positive (+ + +) for surra. Temperature 38° C. Animal slightly depressed.

July 3.—Blood positive (+). Temperature 38.3° C. Given 2.5 grams of naganol.

July 4.—Blood negative. Temperature 39.5° C. Œdema of pendant portion of body. Given 1.3 grams of sodium-antimony tartrate.

July 5.—Blood negative. Temperature 38.8° C. Œdematous swelling slightly subsided; appetite fair.

July 6.—Blood negative. Temperature 37.5° C. Appetite good; condition decidedly improved; animal quite active.

July 7 and 8.—Blood negative. Temperature 38° C.

TABLE 1.—*Data from experiments 1 to 7, showing a summary of the results of the naganol-atoxyl treatment for equine surra.*

Experiment.	Animal.	Weight.		Infected.	Prepatent period.	Treatment.			Results.	Remarks.
		Before infection.	After infection.			Date.	Naganol.	Atoxyl.		
		Kg.	*Kg.*		*Days.*		*g.*	*g.*		
1	75	-------	175	---------------	------	March 18, 1936 March 27, 1936 April 6, 1936	1.750 0.875 0.875	2.63 2.63 2.63	Died May 4, 1936-------	Trypanosomes never recovered; animal developed paresis during course of observation.
2	76	124.5	130	May 18, 1936	7	June 8, 1936 June 14, 1936 June 20, 1936	1.300 0.650 0.650	1.95 2.60 2.60	Died August 19, 1936----	Trypanosomes recovered by animal inoculation.
3	77	138.0	125	October 21, 1936	5	November 9, 1936	2.500	2.50	Died September 5, 1937, 294 days after treatment.	Developed paresis of hind quarters.
4	78	117.0	105	November 18, 1936	11	December 10, 1936	2.100	2.10	Died December 16, 1936--	Paresis developed at time treatment was given and continued up to death.
5	79	102.0	92	December 17, 1936	8	December 30, 1936	1.800	1.80	Died February 1, 1937---	Developed weakness of hind legs; organisms never recovered.
6	80	161.0	160	January 5, 1936	7	January 28, 1937	3.200	3.20	Relapsed May 5, 1937; killed later.	Trypanosomes noted in blood after treatment; animal inoculation showed that virulence was not altered by the drugs.
7	81	128.0	110	April 22, 1937	9	May 14, 1937	2.200	2.20	Died June 15, 1937------	Trypanosomes never recovered; developed weakness of hind quarters.

TABLE 2.—*Data from experiments 8 to 16, showing a summary of the results of the naganol-sodium-antimony tartrate treatment against equine surra.*

Experiment.	Animal.	Weight.		Infected.	Prepatent period.	Treatment.			Results.	Remarks.
		Before infection.	After infection.			Date.	Naganol.	Sodium-antimony tartrate.		
		Kg.	*Kg.*		*Days.*		*g.*	*g.*		
8	82	164.5	138	July 21, 1937	9	August 15, 1937	2.76	1.43	Died August 16, 1937....	Collapsed during the injection of sodium-antimony tartrate.
9	83	111.8	87	August 15, 1937	8	September 6, 1937	1.74	0.65	Died September 11, 1937	
10	84	162.0	174	....do........	9	September 5, 1937	2.58	1.30	Died September 22, 1937	Animal improving during second injection.
						September 18, 1937	2.58	1.30		
11	85	163.0	....	November 13, 1937	12	....	....	....	Died December 3, 1937...	Horse died due to emaciation before treatment was instituted.
12	86	140.0	134	October 11, 1937	7	October 30, 1937	2.00	1.00	Animal still living at present writing.	Increased in weight (to 160 kilograms) and in excellent condition.
13	87	143.0	141	January 29, 1938	8	February 18, 1938	2.12	....	Animal recovered; killed December 20, 1939.	Increased in weight (220 kilograms); complement-fixation test negative.
						February 19, 1938	....	1.30		
14	88	....	245	....	......	March 12, 1938	2.00	1.30	Killed *in extremis* May 3, 1938.	Developed paresis of hind legs.
15	89	....	146	....	......	July 3, 1938	2.50	....	Animal recovered........	After about a year of observation, horse cannot be located.
						July 4, 1938	....	1.30		
16	90	....	216	....	......	July 3, 1938	3.00	....	Died July 12, 1938.......	Autopsy revealed double pneumonia.
						July 4, 1938	....	1.30		

July 9.—Blood negative. Temperature 37.7° C. Œdema which developed after naganol injection completely disappeared.

July 10.—Blood negative. Temperature 37.5° C.

July 14.—Blood negative. Temperature 38.1° C. Complement-fixation test (+ +) in the first and (+ + +) in the second tube.

July 15.—Blood negative. Temperature 38° C. Since the general condition of the animal had decidedly improved, it was delivered to the owner and placed under observation. After about a year had elapsed neither the horse nor the owner could be located.

Experiment 16.—Horse 90. Weight 216 kilograms.

July 3, 1938.—Received in the clinic of the College of Veterinary Science with the complaint of anorexia and general debility. Blood positive (+ +) for surra trypanosomes. Given 3 grams of naganol intravenously in 10 per cent concentration.

July 4.—Blood negative. Temperature 39.9° C. Œdematous swellings noted same as in above experiment. Given 1.3 grams of sodium antimony tartrate.

July 5.—Blood negative. Temperature 40° C. Animal quite depressed with poor appetite. Head carried low. Given hypodermically ⅛ grain of strychnine sulphate in 4 cc of sterile distilled water.

July 6.—Blood negative. Temperature 39.3° C. Appetite slightly improved. Strychnine injection repeated.

July 7.—Blool negative. Temperature 38.7° C. Treated with strychnine sulphate.

July 8.—Blood negative. Temperature 38.4° C. Strychnine sulphate given.

July 9.—Blood negative. Temperature 40.3° C. Appetite poor; animal dull.

July 10.—Blood negative. Temperature 38.5° C. Animal depressed, with marked pneumonic symptoms.

July 11.—Blood negative. Temperature 40° C. Condition unchanged.

July 12.—Animal found dead in the morning. Autopsy revealed both lungs badly hepatized.

For the sake of clarity some of the results of the experiments were condensed and are given in Tables 1 and 2.

THE TREATMENT OF BORNEO HORSES NATURALLY INFECTED WITH SURRA WITH SIMULTANEOUS INJECTIONS OF NAGANOL AND SODIUM-ANTIMONY TARTRATE

Experiment 17.—Because of the encouraging results obtained with the simultaneous treatment of naganol and sodium-antimony tartrate in artificially and naturally infected horses in the Islands, this treatment was tried with the field cases of surra among horses encountered in the British North Borneo (chartered) Company at the time (summer of 1938) the author was detailed in that territory.

The principal vector in this outbreak of surra was a brown horsefly which answered closely the description of *Tabanus fumifer* Walker.[3]

The following is a summary of the clinical manifestations observed in these animals. During the early stage of the disease practically no clinical manifestations were visible, save a variable appetite and intermittent fever. In the course of time progressive emaciation developed. There were periods when the animal was depressed and lethargic and showed accelerated respiration and an augmented heart beat. The jugular vein pulse in some cases was decidedly prominent. The mucous membrane was either injected, icteric, or pale, the last being noticeable during the last stage of the disease. Urticaria was an occasional symptom. Œdema of the pendant portions of the body was noted in protracted cases, although not usually prominent. During the course of the disease some of the animals appeared to improve and the symptoms seemed to subside, only to give way to alarming manifestations later. In the last stage of the disease the gait was observed to be unsteady (off their feet) with a decided knuckling of the fetlocks, indicative of nervous complications. Toward the end the animal was not able to maintain a standing position. A case was noted in the course of this investigation where the pony developed convulsions and coma before death.

While in Kudat district 10 horses were noted positive for surra, in Kota Belud district 92 animals were noted. Most of these positive horses showed no clinical symptoms of the disease. The presence of the causative agent in the blood revealed by microscopic examination of the moist blood preparation was the only indication of the disease in question. In other words, the majority of cases were in the first stage of the disease. Since all the infested animals in Kudat district were mature horses, they were each given a simultaneous injection of naganol and sodium-antimony tartrate in doses of 2 grams and 1.3 grams, respectively. Out of the 10 treated animals only 2 survived, according to a letter received June 19, 1939, after over a year of observation. In Kota Belud district 90 of the 92 surra-positive individuals were actually given the naganol-sodium-antimony treatment; 2 other horses were killed due to the advanced condition of the disease. Observing that the horses treated showed no alarming signs of drug intoxication the doses of the drugs for the adult horses were increased up to 3 grams for naganol and 1.5 grams of sodium-antimony tartrate. This increased dosage was especially indicated in those individuals that were in good condition and showing no indication of the disease except a positive microscopic examination of the blood. For animals about 1 year old the dose was reduced to 1 gram naganol and 0.5 gram sodium-antimony tartrate. Of the 90 treated animals, 61 were still living after observation for 405 days.[4]

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[3] Determined by Dr. Alan Stone, Associate Entomologist, Division of Insect Identification, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington, D. C.

All of the animals treated showed symptoms of naganol poisoning in the form of periproctitis, which disappeared in about 20 days. In some cases which showed œdema of the pendant portion of the abdomen at the time of medication, this symptom was aggravated on treatment but later subsided completely. It was reported that those which failed to respond favorably to the treatment showed nervous complications mainly in the form of paresis of the hind quarters before death.

DISCUSSION

Treatment of equine surra with simultaneous injection of naganol and atoxyl.—Although the terminal result of each of the horses used in experiments 1 to 7 was death, horse 77 in experiment 3 showed indications of apparent recovery at least in terms of the length of time the animal survived after treatment was given. In this case the horse lived approximately 10 months. Further, the infecting organism was recovered from the animal neither by repeated blood examination nor by laboratory animal inoculations. On the other hand, the results of the complement-fixation tests performed at various times during the observation period fluctuated time and again. There was a time when it was negative (June 5, 1936) but it became positive before the animal died. The weakness of the hind legs which developed during the last days of its life suggests that nervous complications had set in. In horses 76 and 80 the organisms were recovered; in the former by animal inoculation and in the later by both microscopic examination of the blood

[4] Thanks are extended to Mr. W. G. Higgins, district agricultural officer, and his assistant, Mr. J. Leaño, for furnishing me a report on the final result of the treatment of surra in British North Borneo.

and animal inoculation. While horses 75 and 76 were given fractional doses spread over a period of 21 days, horses 77 to 81 were given simultaneous single large doses. The results obtained in each group show no significant difference. Lastly, the results recorded in experiments 1 to 7, in connection with the giving of naganol and atoxyl in subtoxic doses as a treatment against surra, do not support the findings of Bubberman, Douwes, van Bergen, and Zijp and Bubberman in the Dutch East Indies, who recorded satisfactory results in the treatment of the disease. These contradictory results may be attributed to a difference in virulence between the strain of trypanosome used in the above series of experiments and that used in the Dutch East Indies, as well as to the stage of the disease when treatment was instituted.

Treatment of equine surra with simultaneous injection of naganol and sodium-antimony tartrate.—Of the five experimentally infected native horses subsequently treated with a combined injection of naganol and sodium-antimony tartrate, 2 recovered from surra infection (Horses 86 and 87). While horse 86 is still living at the present writing, in excellent condition and without trace of the disease, horse 87 was also in good health when killed for anatomy specimen after approximately 1 year and 10 months posttreatment observation. The three other animals died as a result of drug intoxication (horses 82, 83, and 84). Of the three horses that succumbed as a result of the treatment one animal (horse 82) collapsed shortly after the injection of sodium-antimony tartrate. In view of this untoward result, in experiments performed later naganol was injected first and the sodium-antimony salt last. In fact, when the condition of the animal was weakened considerably as a result of the disease, the second injection was administered the day following. Incidentally, the above observation finds a certain amount of support in the findings of Edwards(5) on the use of tartar emetic as a trypanocidal agent. In some of the cases of this worker injection of tartar emetic was followed by drastic results, even sudden death. This investigator attributed this untoward effect to either the occlusion of the blood capillaries or the liberation of toxic substances from the dead trypanosomes. The results obtained in horse 84 suggest that the simultaneous injection of naganol and sodium antimony tartrate should not be repeated within 13 days after the first treatment. Horse 85 died before treatment was given due mainly to the emaciated condition at the time of infection, and hence must be considered a poor risk. Of the three naturally infected horses one recovered, one was killed, and the third died (Table 2). Failure to effect recovery in horse 88 was principally due to comparatively small doses of the drugs. Horse 90 died 9 days after the second injection, not as a result of the direct toxic effects of the drugs but due to a complicating double pneumonia.

The results obtained in both artificially and naturally infected surra animals in experiments 8 to 16, where 3 out of 9 horses recovered from the disease, warrant the statement that naganol-sodium-antimony tartrate is decidedly better than the naganol and atoxyl combination. Moreover, the present findings are in agreement with those of C. Kahan Singh in India, Bakker in the Netherland Indies, and Topacio in the Philippines.

Treatment of equine surra in British North Borneo with the naganol-sodium-antimony-tartrate therapy.—Reference to experiment 17 conducted in British North Borneo at the time the writer was engaged in the control of surra in that territory furnished further data supporting the efficacy of the treatment above discussed. In Kudat district, of the 10 horses treated 2 were reported living after over a year of observation. On the other hand, in Kota Belud district out of 90 surra-positive animals subjected to naganol-sodium-antimony tartrate therapy 61 were still alive after a lapse of more than one year posttreatment observation. In view of the disparity in the number of the treated surra animals in the two districts, a comparative study of the significant difference in the result of the treatment seems useless. However, the high mortality in the Kudat district and the great number of recoveries in the district of Kota Belud may be attributed (*a*) to the fact that the doses given the horses in Kudat were comparatively smaller than those given in Kota Belud district (while the dose administered in the former among adult individuals was 2 grams and 1.3 grams of naganol and sodium-antimony tartrate, respectively, in Kota Belud the dose was 3 grams of naganol and 1.5 grams of the antimony salt); (*b*) as the disease was first observed in Kudat, it is not unlikely that most of the surra treated animals were in a more advanced state than those of Kota Belud in general, although the manifestations did not show it.

Summing up all cases treated, 100 horses were given the naganol-sodium-antimony tartrate combinations. Of this number, 63 animals recovered from the disease. In terms of percentage a recovery of 63 per cent is attained as a result of the drug intervention.

SUMMARY AND CONCLUSIONS

Experiments designed to test the relative value of the naganol and atoxyl combination against naganol-sodium antimony tartrate therapy in the treatment of equine surra were performed.

It has been found that naganol-atoxyl therapy, beyond prolonging the course of the disease, is valueless as a treatment of surra. On the other hand, when naganol is combined with sodium-antimony tartrate and administered in nonlethal but slightly toxic doses, two out of five artificially infected surra horses and one out of three naturally infected animals recovered from the disease. Furthermore, from the field trial carried out in British North Borneo during the summer of 1938, of the 100 horses naturally infected and actually given the naganol sodium-antimony-tartrate combination, 63 were cured of surra.

The above results lead to the conclusion that the naganol-sodium-antimony-tartrate therapy is superior to the naganol and atoxyl combination in the chemotherapy of equine surra.

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TREMATODE PARASITES OF PHILIPPINE VERTEBRATES, IX

FLUKES FROM THE DOMESTIC FOWL AND OTHER BIRDS

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THREE PLATES

Family NOTOCOTYLIDÆ Luehe, 1909

NOTOCOTYLUS INTESTINALIS Tubangui, 1932.

A single specimen of this parasite was found in the intestinal contents of a native chicken. This trematode was originally described by Tubangui(16) from the intestine of a domestic duck.

Host.—*Gallus gallus domesticus.*

Location.—Intestine.

Locality.—Manila? Philippines.

Family EUCOTYLIDÆ Skrjabin, 1924

TAMERLANIA BRAGAI Dos Santos, 1934. Plate 2, fig. 1.

This trematode is also represented by a single specimen found in sedimented material prepared from the intestinal contents of a domestic pigeon. Since the normal habitat of flukes of this type is the urinary tract, it may be assumed that the worm escaped from one of the kidneys or ureters of the host during dissection and became mixed with the intestinal contents. Compared with the members of the genus *Tamerlania* Skrjabin as listed by Penner (1935) it shows great similarity to *T. bragai* Dos Santos (1934), a parasite of pigeons and chickens in Brazil.

Description.—Body 2.5 by 0.4 millimeters. Cuticle armed with numerous small spines. Oral sucker 0.2 millimeter across; pharynx 0.08 by 0.1 millimeter; œsophagus absent; intestinal cæca uniting immediately behind posterior level of vitellaria.

Testes small, oval, symmetrical, immediately postovarial, in middle of second fourth of body length, 0.12 to 0.14 by 0.09 to 0.11 millimeter. Seminal vesicle anterior to and partly overlapped by ovary. Genital pore not seen.

Ovary multilobular, larger than either testis. Vitellaria mostly extracæcal, extending from immediately behind level of intestinal fork to junction of middle and last thirds of body length. Uterus very well developed, its coils filling up most of space behind intestinal fork. Eggs 30 to 33 by 12 to 13 microns.

Host.—Domestic pigeon.

Location.—Kidney.

Locality.—Manila? Philippines.

Family PLAGIORCHIIDÆ Luehe, 1901

PROSTHOGONIMUS PSEUDOPELLUCIDUS sp. nov. Plate 1, figs. 1 and 2.

Numerous specimens of this fluke were collected from the bursa Fabricii of native chickens purchased from the different markets in Manila. More than 200 birds were examined during May and June, 1940, and of these about 8 per cent were found harboring the parasite. We were unable to determine the exact origin of the hosts due to the fact that the chickens sold in Manila come from different localities in the Islands.

Description.—Body ovate, 4.2 to 5.3 by 1.9 to 3.6 millimeters. Cuticle armed with small spines. Oral sucker subterminal, 0.3 to 0.5 millimeter across; acetabulum 0.4 to 0.6 millimeter in diameter, between anterior and middle thirds of body length. Average sucker ratio 1 to 1.2. Prepharynx very short; pharynx 0.10 to 0.13 by 0.13 to 0.17 millimeter; œsophagus 0.18 to 0.29 millimeter long; intestinal cæca reaching posteriorly to level midway between posterior border of testes and posterior end of body or slightly behind that level.

Testes symmetrical, entire, oval, postovarial, at or near middle of body length, 0.42 to 0.64 by 0.29 to 0.37 millimeter. Cirrus pouch elongated, slightly coiled, 0.9 to 1.1 by 0.06 to 0.08 millimeters, extending posteriorly to or a little beyond intestinal bifurcation and inclosing the long seminal vesicle, poorly developed prostate, and short cirrus. Genital pore at anterior end of body, lateral to oral sucker.

Ovary lobulated, with 11 to 25 clustered lobes, 0.4 to 0.5 by 0.5 to 0.58 millimeter, immediately behind and partly overlapped by acetabulum and slightly to one side of median line. Ootype complex, adjacent to posteromedial border of ovary; shell gland very prominent, receptaculum seminis and Laurer's canal present. Uterus loosely coiled, at posterior half of body length, behind ovary and testes; no uterine coils in front of acetabulum. Vitelline follicles tend to be arranged in clusters, of which there are 7 or 8 on the left side and 9 to 12 on the right side; they extend from a little in front of the anterior level of the acetabulum to the level of the testes or more posteriorly. Eggs oval, yellowish, operculated, 22 to 24 by 13 to 13.5 microns, with spine at aboperculated end.

Excretory pore posteroterminal. Excretory bladder characteristically Y-shaped.

Host.—*Gallus gallus domesticus.*

Location.—Bursa Fabricii.

Locality.—Manila? Philippines.

Type specimens.—Philippine Bureau of Science parasitological collection No. 602.

Of the previously described species in the genus *Prosthogonimus* listed by Macy(9) and Witenberg(21) the parasite from the Philippine chicken resembles only *P. pellucidus* in having the acetabulum as large as or only insignificantly larger than the oral sucker. In the other members of the genus the acetabulum is at least two-and-a-half times the size of the oral sucker. *Prosthogonimus pseudopellucidus* may, however, be distinguished from its near relative by the smaller size of the eggs, the equatorial position of the testes, and the extent of the intestinal cæca and vitellaria, the latter reaching anteriorly beyond the level of the anterior border of the acetabulum. In *Prosthogonimus pellucidus* the vitellaria do not reach anteriorly beyond the level of the posterior border of the acetabulum, the testes lie behind the middle of the body length, and the intestinal cæca extend to near the posterior end of the body.

PROSTHOGONIMUS CUNEATUS (Rudolphi, 1809). Plate 1, fig. 3.

A single specimen of this trematode, measuring 3.8 by 1.7 millimeters, was obtained from a chicken. It agrees with the description of *Prosthogonimus cuneatus* (Rudolphi, 1809), as given by Braun,(2) except that it is smaller and its vitellaria extend more towards the anterior end of the body and show a tendency to form clusters.

Host.—*Gallus gallus domesticus.*

Location.—Bursa Fabricii.

Locality.—Manila?, Philippines.

Family ECHINOSTOMATIDÆ Looss, 1902

ECHINOSTOMA REVOLUTUM (Froelich, 1802).

This trematode has been reported by Tubangui(16) from the Philippine domestic duck and experimental pigeons. The same writer also determined that the parasite utilizes the snail, *Lymnæa* (*Radix*) *swinhoe* var. *quadrasi* von Moellendorff,[1] as primary and secondary intermediate host.

Host.—*Gallus gallus domesticus.*

Location.—Intestine.

Locality.—Manila?, Philippines.

EPISTHMIUM GALLINUM sp. nov. Plate 3, fig. 1.

A single specimen of this trematode was found in the bursa Fabricii of a chicken. It is apparently a very rare parasite of chickens, for we have made repeated attempts to secure additional material with negative results.

Description.—Body 1.1 by 0.4 millimeters; dorsal surface up to level of anterior border of acetabulum and ventral surface to level of second testis covered sparsely with spines. Oral sucker subterminal, 0.1 millimeter in diameter; acetabulum equatorial, 0.13 millimeter across. Cephalic collar vestigial, 0.17 millimeter across; collar spines, of which only four are visible on each side, poorly developed, 15 microns long, only slightly larger than body spines. Prepharynx very short; pharynx 0.08 by 0.09 millimeter; œsophagus 0.17 millimeter long; intestinal cæca reaching to near posterior end of body.

Testes postovarial, in middle of last third of body length, one immediately and obliquely behind the other; anterior testis median, more or less circular in outline, 0.16 millimeter in diameter; posterior testis displaced to right side of median line, oval, 0.16 by 0.1 millimeter. Cirrus sac small, pyriform, 0.08 by 0.07 millimeter, on right side of median line, immediately in front of acetabulum and inclosing small seminal vesicle, poorly developed pars prostatica, and short cirrus. Genital pore median, about midway between intestinal fork and anterior border of acetabulum.

Ovary small, subglobular, 0.09 by 0.08 millimeter, to right side of median line, about midway between acetabulum and first testis. Shell gland very profuse, between ovary and anterior testis, stretching transversely from one inner cæcal wall to the other. Uterus short, with few (2) eggs. Vitellaria moderately developed, mostly extracæcal, extending from immediately in front of level of œsophageal bifurcation to posterior end of body;

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[1] According to the nomenclature used by Bequaert and Clench(1) for Philippine lymnæid snails, this should be the name of the mollusc which was designated by Tubangui (1932) as *Lymnæa peregra* (Mueller).

they meet anteriorly and posteriorly. Eggs oval, yellowish, operculated, 82 to 98 by 49 to 56 microns.

Host.—*Gallus gallus domesticus.*

Location.—Bursa Fabricii.

Locality.—Manila?, Philippines.

Type specimen.—Philippine Bureau of Science parasitological collection No. 605.

The genus *Episthmium* Luehe, 1909, is regarded by Odhner (10) and Fuhrmann (6) as a synonym of the genus *Echinochasmus* Dietz, 1909. In placing our species in the former genus we have merely followed Travassos, (18) who described a closely related parasite of the chicken in Brazil under the name *Episthmium oscari.* If both the Brazilian and Philippine helminths possessed well-developed cephalic collars and spines, they would be generically related to a parasite of the dog in India which Verma (19) described under the name *Episthochasmus caninum. Episthmium gallinum* differs from *E. oscari* only in the very small dimensions of its body, its various organs, and eggs.

Family BRACHYLÆMIDÆ Joyeux and Foley, 1930

Syn.: HARMOSTOMIDÆ Witenberg, 1925

BRACHYLÆMUS MALAYENSIS sp. nov. Plate 2, fig. 2.

Two adult specimens of this trematode were collected from a chicken. The parasite should have been placed in the genus *Harmostomum* Braun, 1899, but, according to Joyeux and Foley, (7) the older generic name *Brachylæmus* Dujardin, 1843, refers to the same group of helminths.

Description.—Body elongated, 2 to 2.2 by 0.45 to 0.5 millimeters. Cuticle armed with minute spines from anterior end to near posterior end of body. Oral sucker subterminal, 0.22 by 0.24 to 0.28 by 0.23 millimeter; acetabulum slightly larger than oral sucker, circular in outline, 0.28 to 0.31 millimeter across, at junction of anterior and middle thirds of body length. Mouth opening slitlike, longitudinal; prepharynx tubular, very short; pharynx globular, 0.13 millimeter across; œsophagus absent; intestinal cæca very irregularly twisted, serpentine, reaching to near posterior end of body.

Testes tandem, near posterior end of body, their margins entire; anterior testis 0.2 to 0.22 by 0.28 to 0.32, posterior testis 0.22 to 0.24 by 0.26 to 0.28 millimeter. Vesicula seminalis long and coiled, immediately in front of first testis. Cirrus sac oval, to one side of median line, 0.15 to 0.19 by 0.07 to 0.08 millimeter. Genital pore median or slightly to one side of median line, immediately in front of first testis.

Ovary transversely oval, intertesticular, to one side of median line, 0.12 to 0.13 by 0.18 to 0.22 millimeter. Transverse vitelline ducts as well as vitelline reservoir and shell gland, both of which are inconspicuous, ventral to ovary. Uterus long, with ascending and descending transverse coils, occupying most of intercæcal space in front of anterior testis but not extending beyond acetabular level. Vitelline follicles lateral and mostly extracæcal, extending from middle level of acetabulum to anterior border of first testis or a little in front of that level. Eggs small, oval, operculated, yellowish to brownish, 21 to 23 by 11 to 13 microns.

Excretory pore posterodorsal.

Host.—*Gallus gallus domesticus.*

Location.—Cloaca.

Locality.—Manila?, Philippines.

Type specimens.—Philippine Bureau of Science parastiological collection No. 609.

The Philippine parasite needs only to be compared with the following trematodes which have been reported from chickens in different parts of the world and with which it is most closely related: *Brachylæmus commutatus* (Diesing, 1858) in southern Europe and northern Africa; *B. gallinus* (Witenberg, 1923) in Russian Turkestan; *B. annamensis* (Railliet, 1924) in French Indo-China; *B. horizawai* (Ozaki, 1925) in Japan; and *B. hawaiiensis* (Guberlet, 1928) in Hawaii. The zoological status of these various trematodes is, however, under question. According to Yamaguti (22) *B. horizawai* is identical with *B. gallinus*, while, according to Sinitsin (14) both *B. gallinus* and *B. hawaiiensis* are synonyms of *B. commutatus*. Dollfus, (5) on the other hand, recognizes only *B. commutatus* as valid and regards all the other forms either as synonyms or as varieties of that species. *Brachylæmus malayensis* differs from these different parasites in the relative sizes of its two suckers, the shape of the oral opening, the anterior extent of the uterine coils, and the small size of the eggs.

Family CYATHOCOTYLIDÆ Poche, 1925

MESOSTEPHANUS FREGATUS sp. nov. Plate 3, fig. 2.

Description.—Body 0.6 to 1.3 millimeters long by 0.35 to 0.6 millimeter in maximum width across ovary; divided into a widened anterior part and a short conical posterior part, 0.06 to 0.11 millimeter long; lateral borders of anterior part rolled ventrally and meeting posteriorly at a distance of 0.25 to 0.35 millimeter from posterior end of body. Cuticle armed with numerous minute spines. Oral sucker 0.034 to 0.053 by 0.037 to 0.06 millimeter; pharynx 0.026 to 0.04 by 0.026 to 0.037 millimeter; œsophagus 0.015 to 0.7 millimeter long; intestinal cæca reaching to level of posterior border of second testis. Acetabulum 0.03 to 0.53 by 0.04 to 0.064 millimeter, at junction of anterior and middle thirds of body length. Adhesive organ oval, 0.15 to 0.16 by 0.11 to 0.13 millimeter, a short distance behind acetabulum, with a longitudinal depression.

Testes almost tandem, subspherical to oval; anterior testis partly dorsal to adhesive organ, smaller than posterior testis, 0.11 to 0.24 by 0.14 to 0.24 millimeter, its anterior border usually notched; posterior testis 0.16 to 0.3 by 0.18 to 0.27 millimeter, its posterior border sometimes presenting a notch. Cirrus sac elongated, to one side of median line, 0.3 to 0.44 by 0.05 to 0.08 millimeter, reaching anteriorly to posterior border of first testis or slightly beyond that level and inclosing coiled seminal vesicle, well-developed pars prostatica, and long cirrus. Genital pore at posterior end of body, directed dorsally and communicating with a small genital sinus.

Ovary small, 0.07 to 0.1 by 0.06 to 0.1 millimeter, to one side of median line opposite cirrus sac, adjacent to posterolateral border of first testis. Vitellaria very well developed, consisting of large roundish or irregularly shaped follicles and forming an almost complete circle around adhesive organ and first testis. Uterus short, containing 1 to 7 eggs; vaginal sphincter moderately developed. Eggs oval, yellowish, operculated, 86 to 98 by 67 to 75 microns.

Host.—*Fregata ariel ariel.*

Location.—Small intestine.

Locality.—Obando, Bulacan Province, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection No. 547.

The genus *Mesostephanus* Lutz, 1935, comprises the following previously described species: *M. appendiculatus* (Ciurea, 1916), *M. appendiculatoides* (Price, 1934), *M. fajardensis* (Price, 1934), *M. milvi* Yamaguti, 1939, and *M. burmanicus* Chatterji, 1940. Compared with these, *M. fregatus* bears the closest resemblance to *M. appendiculatus* and *M. milvi.* It may be distinguished from *M. appendiculatus* by the more profuse development of its vitellaria, the more anterior position of its acetabulum, and its slenderer cirrus sac; and from *M. milvi* by the smaller size of its cirrus sac and adhesive organ, its relatively longer intestinal cæca, and the presence of a vaginal sphincter.

MESOSTEPHANUS HALIASTURUS sp. nov. Plate 3, fig. 3.

Description.—Body 0.7 to 0.9 millimeter long by 0.3 to 0.4 millimeter in maximum width across ovary; anterior part well expanded, its lateral borders rolled ventrally and meeting posteriorly at a level 0.18 to 0.25 millimeter from posterior end of body; posterior part short, 0.05 to 0.11 millimeter long. Cuticle armed with numerous small spines. Oral sucker subterminal, 0.04 to 0.06 by 0.05 to 0.06 millimeter; acetabulum equatorial, slightly larger than oral sucker, 0.05 to 0.07 millimeter in diameter. Pharynx 0.03 to 0.05 millimeter across; œsophagus 0.04 to 0.08 millimeter long; intestinal cæca extending posteriorly as far as junction of anterior and posterior parts of body. Adhesive organ 0.13 to 0.15 by 0.09 to 0.13 millimeter, with a longitudinal depression.

Testes subglobular to oval, tandem, postequatorial; anterior testis partly dorsal to adhesive organ, 0.08 to 0.11 by 0.09 to 0.12 millimeter; posterior testis 0.08 to 0.11 by 0.10 to 0.13 millimeter. Cirrus sac elongated, to one side of median line, 0.22 to 0.37 by 0.06 to 0.08 millimeter, reaching anteriorly to middle level of first testis or even beyond that level. Genital pore at posterior end of body, directed dorsally and communicating with a shallow genital sinus.

Ovary globular, 0.05 to 0.07 millimeter in diameter, slightly to one side of median line opposite cirrus sac, ventral to first testis. Vitellaria moderately developed, consisting of small elongate follicles and forming a complete ring around adhesive organ. Uterus short, with 1 to 3 eggs; vaginal sphincter well developed. Eggs oval, yellowish, operculated, 83 to 98 by 64 to 83 microns.

Host.—*Haliastur intermedius.*

Location.—Small intestine.

Locality.—Pampanga Province, Luzon.

Type specimens.—Philippine Bureau of Science parasitological collection No. 563.

The above parasite appears to be very closely related to *Mesostephanus appendiculatus* and *M. appendiculatoides.* It may be distinguished from the former, however, by its longer œso-

and its smaller cirrus sac, adhesive organ and eggs; from the latter by the more expanded anterior part of its the lateral borders of which are rolled ventrally.

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ILLUSTRATIONS

[Drawings by Baldomero Escuardo.]

PLATE 1

FIG. 1. *Prosthogonimus pseudopellucidus* sp. nov., entire worm, ventral view, with vitellaria reaching posteriorly beyond posterior level of testes.

2. *Prosthogonimus pseudopellucidus* sp. nov.; entire worm, ventral view, with vitellaria extending posteriorly only to anterior level of testes.

3. *Prosthogonimus cuneatus* (Rudolphi, 1809); entire worm, ventral view.

PLATE 2

FIG. 1. *Tamerlania bragai* Dos Santos, 1934; entire worm, ventral view.

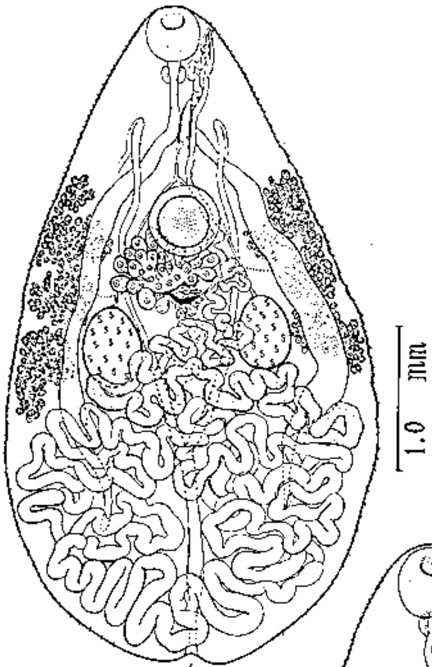
2. *Brachylæmus malayensis* sp. nov.; entire worm, ventral view.

PLATE 3

FIG. 1. *Episthmium gallinum* sp. nov.; entire worm, ventral view.

2. *Mesostephanus fregatus* sp. nov.; entire worm, ventral view.

3. *Mesostephanus haliasturus* sp. nov.; entire worm, ventral view.



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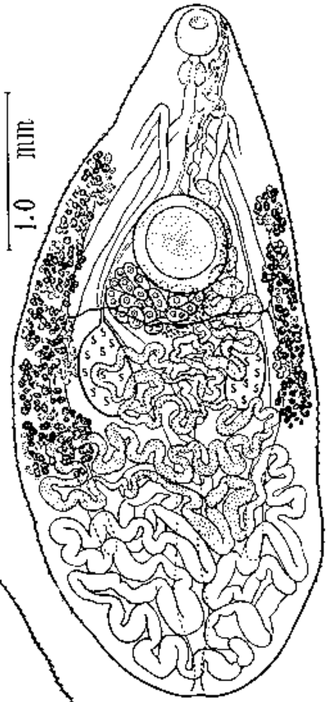

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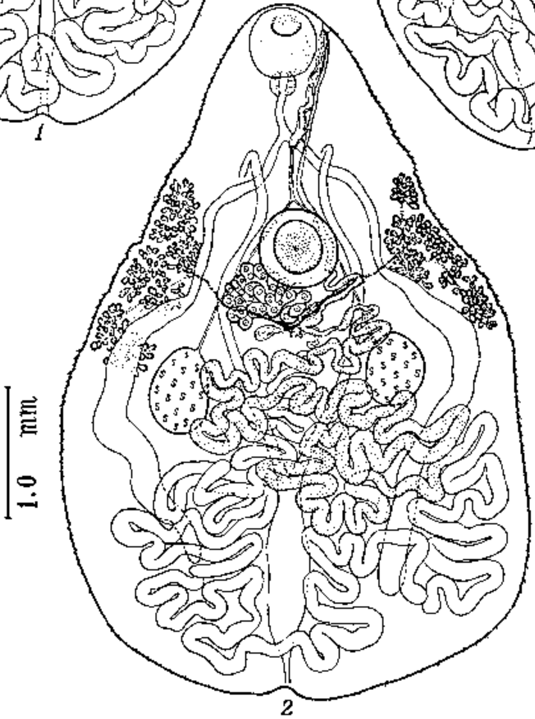

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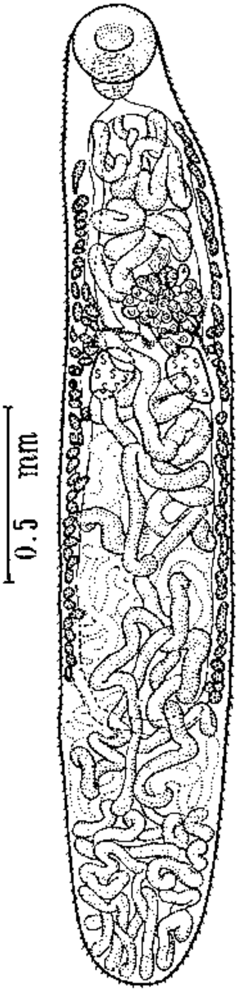
PLATE 1.



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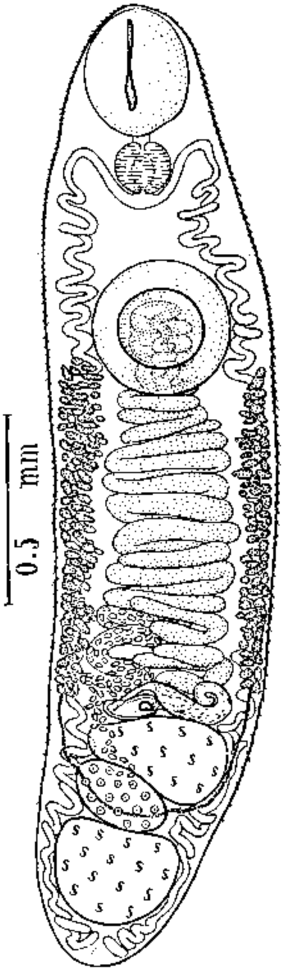

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PLATE 2.

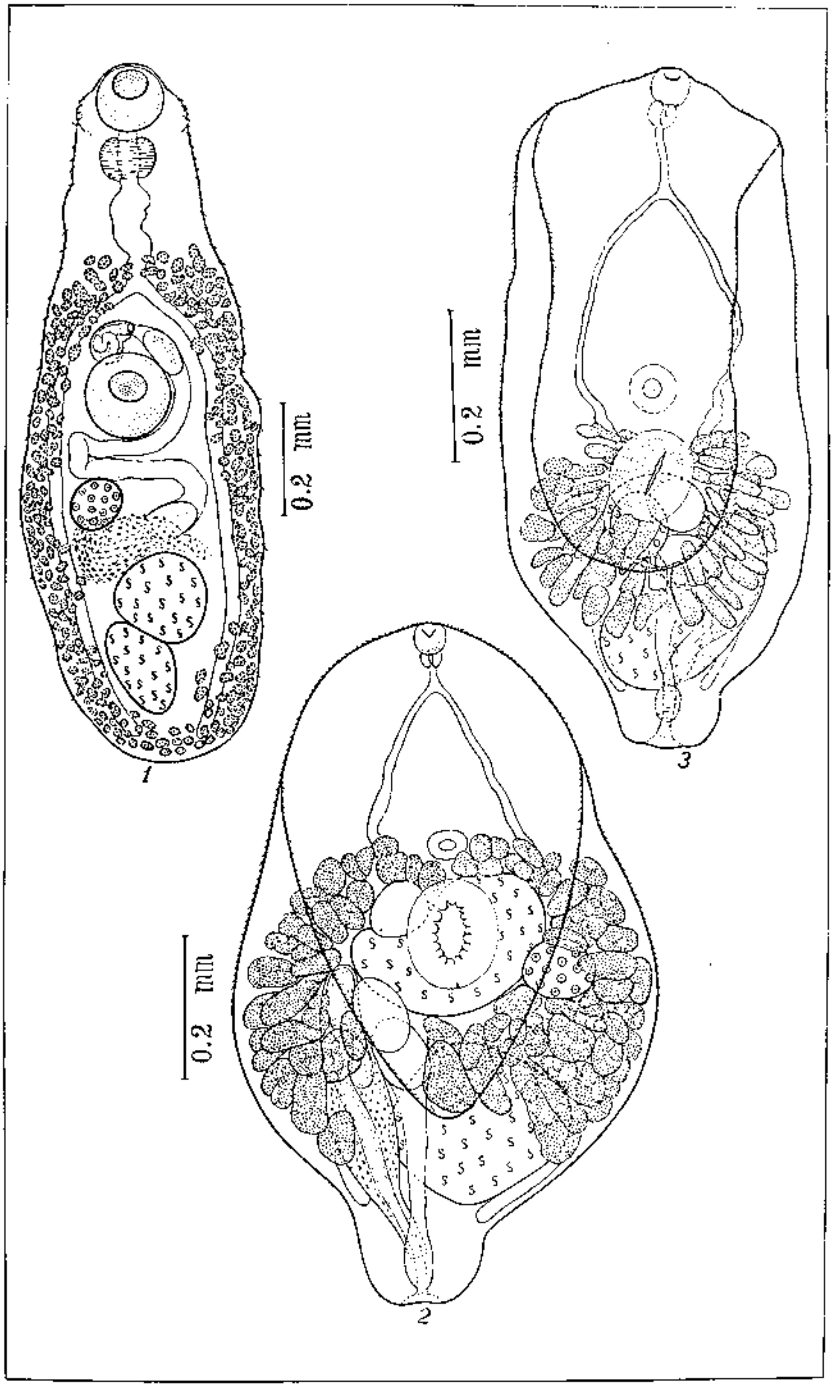

PLATE 3.

CHEMICAL STUDIES ON COCONUT PRODUCTS, IV

FURTHER DATA ON A NEW PROCESS FOR THE EXTRACTION OF COCONUT OIL

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ONE TEXT FIGURE

In a previous article[1] it has been pointed out that, since the present manufacture of coconut oil involves a stage (the copra stage) in which the moisture content of the dried coconut meat cannot easily be controlled during drying, storage, and transportation, and which therefore is responsible for the development of molds, copra bugs, and other contaminations, and for the consequent deterioration of the quantity and quality of the oil and its byproducts, a more profitable way of utilizing the coconut should start directly with the fresh meat. It has also been shown in the article cited that as between the cage hydraulic press and the roller mill the latter gives better results from the standpoint of efficiency of oil extraction.

The present article gives more detailed data on the extraction of coconut oil emulsion by the roller mill. The experiments on which these data are based were carried out beginning March and ending June, 1940. Various factors were studied; namely, effects of pressure, water dilution, successive order of pressing, and particle size.

The rollers used, made of cast iron, were those described in the article cited above, except that their effective length was decreased from 28 to 24 inches, due to certain improvements made necessary for preventing the flow of the coconut oil emulsion along with the pressed meat. This time, however, the amount of water mixed with the meat was definitely controlled and the meat and water were thoroughly mixed before being placed on the feeder which was actuated by a cam.

Unfortunately these rollers were not equipped with a pressure indicator, and our results cannot therefore be expressed in terms of definite pressures; however, in view of the nature of our data, specially those referring to the oil content of the dried cake, it should not be difficult to duplicate our findings with rollers which are equipped with a pressure gage.[2]

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[1] V. G. Lava, P. E. Torres, and S. Sanvictores, Chemical Studies on coconut products, III. Philip. Journ. Sci. 74 (1941) 247–283.

EXPERIMENTAL DATA

Table 1 shows the effects of pressure and of the amount of water mixed with the comminuted coconut meat on the efficiency of oil extraction and on the time of extraction.

The rollers had a speed of 3.9 R. P. M.; the water used was such as to give a temperature to the mixture of meat and water of around 41 to 46° C.; and the average size of the comminuted particles of coconut meat was 10.4 by 5 by 2.1 mm. The pressures indicated are all empirical. They show distances from a certain fixed stratum to a movable point attached to the upper roller, and thus indicate the distances to which the springs of the rollers have been pressed. For example, the difference between pressure index 79 and pressure index 84 is that for the latter pressure the springs have been further pressed a distance of 5 mm. In all the experiments in Table 1, 50 nuts were used in each batch, although the calculations are for 1,000 nuts.

Due to the comparatively small number of nuts used, and the consequently unreliable determination of actual oil yield, the method used in this work for calculating the efficiency of oil extraction was to weigh the fresh meat and the cakes produced, and to determine the water and oil contents of samples of fresh meat, and of the coconut cakes from the first, second, and third pressings. From these data the amounts of oil and nonoil solids extracted from the fresh meat were calculated, and the efficiency of oil extraction determined.

Table 2 shows the effects of the amount of water mixed with the comminuted meat and of the successive order of pressures used, on the efficiency of oil extraction and on the time of extraction. Here again the rollers had a speed of 3.9 R. P. M. and the average size of the comminuted meat was 10.4 by 5 by 2.1 mm. The temperature of the water used was around 30° C. In all the experiments in Table 2 as well as in Table 4, 100 nuts

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[2] Tests made by the Honolulu Iron Works, Manila, show that the relation between the load and the pressure index may be defined by the linear equation $x = \frac{y—61}{0.0082}$, where x = load in kilograms, and y = pressure index in millimeters.

TABLE 1.—*Effects of pressure and dilution on the efficiency of oil extraction from, and on the time of extraction of, ground coconut meat.*

Speed of rollers, 3.9 R.P.M.
Temperature of mixture of meat with water, 41–46°C.
Average particle size, 10.4 × 5 × 2.1 mm.
The nuts were obtained from Cabubuhayan, Calumpang, Laguna Province.

Experiment.	Weight per 1,000 nuts.	Weight of fresh meat per 1,000 nuts.	Water in fresh meat, wet basis.	Oil in fresh meat, wet basis.	Nonoil solids in fresh meat, wet basis.	Pressure used, empirical.	Water used, based on actual weight.			Weight of cake in different pressings, based on weight of fresh meat.		
							Pressing.					
							1	2	3	1	2	3
	Kg.	*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*mm.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
3	755	355	52.9	31.3	15.8	79	0	50	50	58	39	36
4	745	336	53.6	30.4	16.0	79	50	50	50	55	42	39
5	745	360	54.3	32.0	13.7	79	100	100	100	56	44	38
6	710	330	51.3	33.3	15.4	81	0	50	50	52	36	32
7	725	380	51.2	33.0	15.8	81	50	50	50	51	41	33
8	750	385	54.9	30.4	14.7	81	100	100	100	49	36	34
9	758	365	51.7	33.2	15.1	83	0	50	50	40	32	29
10	770	370	52.2	31.8	16.0	83	50	50	50	42	35	33
11	774	375	51.8	32.6	15.6	83	100	100	100	41	34	32
12	770	355	51.0	33.5	15.5	84	0	50	50	34	33	31
13	779	365	51.8	32.6	15.6	84	50	50	50	31	29	28
14	775	365	52.6	33.0	14.4	84	100	100	100	32	31	30

Table 1.—*Effects of pressure and dilution on the efficiency of oil extraction from, and on the time of extraction of, ground coconut meat*—Continued.

Experiment.	Oil extracted in different pressings.			Nonoil solids extracted in different pressings.			Time of extraction in different pressings, in minutes per 1,000 nuts.			Remarks.
	Pressing.									
	1	2	3	1	2	3	1	2	3	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*min.*	*min.*	*min.*	
3	60	79	85	21	37	45	220	104	104	Good mats of pressed cake.
4	56	69	73	31	46	48	70	80	84	
5	58	67	74	24	35	39	60	68	70	
6	65	79	84	18	39	45	104	72	80	
7	67	73	81	36	38	46	72	80	80	
8	60	75	80	33	40	42	102	108	116	
9	79	93	96	26	27	37	960	300	260	Extraction difficult and messy.
10	71	86	92	30	37	37	140	400	280	Little extract from second and third extractions.
11	71	86	90	34	37	37	200	280	260	
12	82	93	95	27	30	42	800	320	280	Extraction difficult and messy.
13	83	92	96	40	42	46	240	360	260	Very little extract from 2d and 3d extractions.
14	83	92	96	27	28	35	240	360	240	Good mat in first extraction; some feed pressure necessary for second and third extractions.

TABLE 2.—*Effects of dilution and of varying order of successive pressures on the efficiency of oil extraction and on the time of extraction.*

Speed of rollers, 3.9 R.P.M.
Temperature of water used, 30°C.
Average particle size, 10.4 by 5 by 2.1 mm.

Experiment.	Weight of 1,000 nuts.	Weight of fresh meat per 1,000 nuts.	Water in fresh meat, wet basis.	Oil in fresh meat, wet basis.	Nonoil solids in fresh meat, wet basis.	Pressure used, empirical.	Water used, based on actual weight.			Cake in different pressings, based on weight of fresh meat.			Oil extraction in different pressings.			Nonoil solids extraction in different pressings.			Time of extraction in different pressings, minutes per 1,000 nuts.		
							Pressing.														
							1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	Kg.	*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*mm.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*min.*	*min.*	*min.*
15	774	335	51.3	33.0	15.7	1-82	75			49			66			30			100		
						2-82	50	100		49	37		65	81		25	30		110	108	
						3-82	25		100	50		33	64		85	23		35	112		125
							0			48			70			35			160		
16	796	385	51.5	34.0	14.5	1-82	75			48			65			28			100		
						2-81	50	100		50	37			79			36		104	90	
						3-80	25		100	50		35	64		80	21		45	130		85
							0			45			71			20			180		
17	783	377	52.0	32.1	15.9	1-80	50			55			59			23			91		
						2-81		100			43			70			30			96	
						3-82			100			37			79			38			122
[a]18	788	366	50.3	35.0	14.7	1-83	50			44			72			31			260		
						2-83		100			34			84			45			180	
						3-83			100			31			91			51			160
20	788	353	51.9	32.2	15.9	1-84	50			34			77			30			260		
						2-84		100			32			91			43			290	
						3-84			100			32			96			48			220
21	779	363	50.1	33.0	16.9	1-82	50			48			63			36			150		
						2-83		100			32			83			46			150	
						2-84			100			25			90			47			175

[a] Beginning with this experiment, the feeder actuated by the cam was taken away, and feeding was done by hand alone.

were used in each batch, although the calculations are for 1,000 nuts. From Experiment 18 of Table 2 to the end of the experiments in Table 4, feeding by hand alone was substituted for feeding with the help of a cam.

Table 3 not only gives a resumé of Tables 1 and 2 but also shows the effects of pressure and of the amount of water mixed with the comminuted meat, on the oil content of the dried pressed coconut meat (after the third pressing).

Table 4 shows the effects of the speed of the rollers, of the average size of the particles of comminuted meat, and of pressure, on the efficiency of oil extraction, on the oil content of the dried pressed coconut meat, on the time of extraction, and on the amount of tailings produced.

In Tables 1, 2, and 4 the weights of 1,000 husked nuts and fresh meat, and the percentages of water, total obtainable oil, and nonoil solids are given.

The possible errors in measurements of weight of fresh meat throughout the above experiments may be considered not more than 2 in 39 or around 5 per cent.

DISCUSSION OF RESULTS

In Table 1, for the same pressure, different amounts of water were used. In one case no water at all was used. In the first pressing, and 50 per cent water, based on the weights of the pressed meat, in the second and third pressings; in another case 50 per cent water was used in the first pressing, based on the weight of the fresh meat, and 50 per cent water, based on the weights of the pressed meat, in the second and third pressings; in the third case 100 per cent water was used in the first pressing, based on the weight of the fresh meat, and 100 per cent water, based on the weights of the pressed meat, in the second and third pressings.

Table 1 shows that while the less the amount of water used for mixing with the meat the greater is the degree of extraction of oil, especially for the lower pressures, at the same time the period of extraction becomes longer when less water is used. In general, when 50 per cent water is used in the first pressing, based on the weight of the fresh meat, the period of extraction is least; and for the second and third extractions, 100 per cent water, based on the weight of the pressed coconut meat, seems to be necessary for reducing the period of extraction to the minimum.

TABLE 3.—*Effects of pressure and dilution on the oil content of the sapal.*

Speed of rollers, 3.9 R.P.M.
Temperature of water 30-46°C.
Average particle size, 10.4 by 5.0 by 2.1 mm.

Experiment.	Pressure, empirical.	Water used, based on weight of fresh meat.			Cake after pressing, based on fresh meat.			Oil in cake from different pressings, dry basis.			Efficiency of oil extraction in different pressings.		
		Pressing.											
		1	2	3	1	2	3	1	2	3	1	2	3
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
3	79	0	50	50	53	39	36	49.9	38.9	33.5	60	79	85
4	79	50	50	50	55	42	39	54.7	52.6	49.8	56	69	73
5	79	100	100	100	56	44	38	56.9	54.0	49.2	58	67	74
6	81	0	50	50	52	36	32	48.1	43.1	38.8	65	79	84
7	81	50	50	50	51	41	33	52.0	48.6	42.9	67	73	81
8	81	100	100	100	49	36	34	55.4	47.1	40.6	60	75	80
9	83	0	50	50	40	32	29	35.6	17.0	11.2	79	93	96
10	83	50	50	50	42	35	33	47.8	28.7	18.5	71	86	92
11	83	100	100	100	41	34	32	49.0	33.9	24.0	71	86	90
12	84	0	50	50	34	33	31	34.8	16.8	15.7	82	93	95
13	84	50	50	50	31	29	28	36.0	19.2	14.0	83	92	96
14	84	100	100	100	32	31	30	38.0	21.7	12.8	83	92	96
15	82	[a]38	100	100	49	37	33	48.8	37.0	34.2	[a]66	81	85
16	82, 81, 80	[a]38	100	100	48	37	35	50.1	44.0	37.8	[a]67	79	80
17	80, 81, 82	50	100	100	55	43	37	52.0	48.2	41.9	59	70	79
18	83	50	100	100	44	34	31	48.0	40.5	29.8	72	84	91
20	84	50	100	100	34	32	32	39.5	24.5	15.6	77	91	96
21	82, 83, 84	50	100	100	48	32	25	52.6	39.6	27.6	63	83	90

[a] Average value.

TABLE 4.—*Effects of speed of rollers, of particle size, and of pressure on the efficiency of oil extraction, time of extraction, and on the amount of tailings produced.*

Water used in first pressing, 50 per cent of fresh meat.
Water used in second pressing, 100 per cent of 1st pressed meat.
Water used in third pressing, 100 per cent of 2d pressed meat.
Temperature of water used, 30°C.

Experiment.	Source of nuts.	Weight per 1,000 nuts.	Weight of fresh meat per 1,000 nuts.	Water in fresh meat, wet basis.	Oil in fresh meat, wet basis.	Nonoil solids in fresh meat, wet basis.	Speed of rollers.	Pressure used, empirical.	Average size of particles.	Cake in different pressings, based on fresh meat.			Tailings in different pressings.		
										Pressing.					
										1	2	3	1	2	3
		Kg.	*Kg.*	*Per cent.*	*Per cent.*	*Per cent.*	*r. p. m.*	*mm.*		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18	Cabubuhayan, Calumpang.	788	366	50.3	35.0	14.7	3.9	83	10.4×5.0×2.1	44	34	31	3	8	10
20	....do..........	788	353	51.9	32.2	15.9	3.9	84	10.4×5.0×2.1	34	32	32	(?)	10	25
21	....do..........	779	363	50.1	33.0	16.9	3.9	82,83,84	10.4×5.0×2.1	48	32	25	2	7	16
22	....do..........	774	354	50.3	33.9	15.8	5.4	83	10.4×5.0×2.1	39	30	30	11	25	34
23	....do..........	782	355	51.5	32.9	15.6	5.4	82,83,84	10.4×5.0×2.1	45	29	27	2	12	22
24	....do..........	780	348	53.0	31.1	15.9	3.6	83	10.4×5.0×2.1	45	32	28	3	7	12
25	Nagcarlang.....	800	400	52.4	31.7	15.9	3.6	83,83,84	10.4×5.0×2.1	40	28	26	5	11	20
26	....do..........	811	440	50.5	33.6	15.9	3.6	83,84,84	10.4×5.0×2.1	45	28	25	4	11	12
27	....do..........	806	434	51.6	32.3	16.1	3.6	83,84,84	6.2×2.2×1.0	35	25	25	5	11	14
28	....do..........	819	461	52.3	31.8	15.9	3.6	83,84,84	11.0×7.2×3.3	47	29	26	3	8	11
29	Riverside, Calumpang.	805	422	49.7	34.4	15.9	3.6	84	7.1×2.5×1.2	33	26	25	4	8	11
30	....do..........	803	431	49.7	34.3	16.0	3.6	84	5.9×1.8×0.9	28	24	25	13	13	17
[a] 31	....do..........	801	419	50.6	33.4	16.0	3.6	84	5.9×1.8×0.9	32	27	23	6	10	14
[b] 32	Nagcarlang.....	818	416	50.6	33.4	16.0	3.6	84	5.9×1.8×0.9	28	25	24	12	18	20

Experiment.	Time of extraction in different pressings, minutes per 1,000 nuts.			Efficiency of oil extraction.			Efficiency of extraction of nonoil solids.			Oil in different pressings, dry basis.			Remarks.
	Pressing.												
	1	2	3	1	2	3	1	2	3	1	2	3	
	min.	*min.*	*min.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
18	260	180	160	72	84	91	31	45	51	48.0	40.5	29.8	
20	260	290	220	77	91	96	30	43	48	39.5	24.5	15.6	
21	150	150	175	63	83	90	36	46	47	52.6	39.6	27.6	
22	210	240	170	77	91	95	33	46	46	42.1	25.3	13.8	
23	150	160	205	68	87	93	35	45	45	50.1	32.7	20.3	Very little extract in third extraction.
24	185	180	157	67	82	88	34	45	45	48.9	38.0	29.3	
25	270	200	190	73	87	91	39	44	44	46.6	33.9	24.8	
26	215	240	180	68	87	92	33	44	44	50.5	33.5	23.3	
27	235	210	150	79	89	92	43	48	48	43.0	29.1	21.1	Fresh meat ground twice before extraction.
28	240	230	200	57	84	91	42	45	45	59.7	36.8	25.4	Very good continuous mat even in third extraction.
29	225	160	125	81	90	93	40	46	46	41.7	28.8	20.9	Very good paperlike mat in 3d extraction.
30	280	180	160	88	94	96	41	41	41	31.6	17.0	12.2	Do.
[a] 31	230	240	120	85	91	94	45	45	48	37.1	23.4	20.4	Do.
[b] 32	260	180	156	86	93	95	46	46	48	34.5	21.7	16.0	Do.

[a] Water used in 1st extraction, 75 per cent.
Water used in 2d extraction, 50 per cent.
Water used in 3d extraction, 0 per cent.

[b] Water used in 1st extraction, 50 per cent.
Water used in 2d extraction, 100 per cent.
Water used in 3d extraction, 50 per cent.

Table 1 also shows that while a pressure equivalent to our empirical pressure index 79 will give an oil extraction of 73 to 85 per cent, at pressure index 84 we can get an oil extraction as high as 96 per cent. The difference in the use of these two pressures, from the standpoint of period of extraction, is that while with the lower pressure around 20,000 nuts per day of 24 hours can be pressed by the rollers used, with the higher pressure only around 6,000 nuts can be pressed per day.

Table 2 confirms the above conclusions. In Experiments 15 and 16, in the first pressing, when no water is mixed with the comminuted meat, although the degree of oil extraction is comparatively higher, the period of extraction is much longer than when water is used. Again these two experiments indicate that 50 per cent water mixed with the meat before pressing gives good results. The use of 75 per cent water, while giving a slightly shorter period of extraction, has also the effect of diluting the skimmed coconut milk obtained after centrifuging the coconut oil emulsion, which is not advisable, especially if this skimmed coconut milk byproduct may have to be evaporated later.

Experiments 15, 16, and 17 show clearly that a high pressure used throughout the three extractions (82) gives a higher efficiency of extraction than when it is used as a maximum pressure only, either at the beginning (82, 81, 80) or at the end (80, 81, 82). This result is also verified by Experiments 20 and 21.

Under the conditions of the experiment a 96 per cent oil extraction can be obtained with a pressure index of 84 throughout the three pressings (Experiment 20), at a rate of pressing of around 5,500 nuts per day.

From Experiment 18, in Table 2, up to the end of the experiments in Table 4, the feeder actuated by a cam was taken away, and feeding was done by hand alone; this change was found necessary with the use of high pressures, since the consistency of the meat-water mixture apparently prevented a constant and continuous feed into the rollers unless the mixture was moved back and forth along the length of the roller.

In the case of the extraction of nonoil solids, Table 2 shows that while with pressure index 82 (Experiment 15) around 35 per cent of the total nonoil solids is extracted, with pressure index 83 (Experiment 18) the degree of extraction is around 51 per cent, and with pressure index 84 (Experiment 20) the degree of extraction is around 48 per cent. The increase in the extraction of nonoil solids, when the pressure is not continuously at its highest (Experiments 16 and 17 as compared with Experiment 15) requires further elucidation, especially in view of the fact that in Table 1 fairly great variations were found in the degree of extraction of these nonoil solids with changes in the amount of water used for mixing and sometimes even with no changes at all in the amount of water.

The relation between the efficiency of oil extraction and pressure, from Experiments 20, 18, 15, 7, and 4 (Table 3), is plotted as shown in text fig. 1.

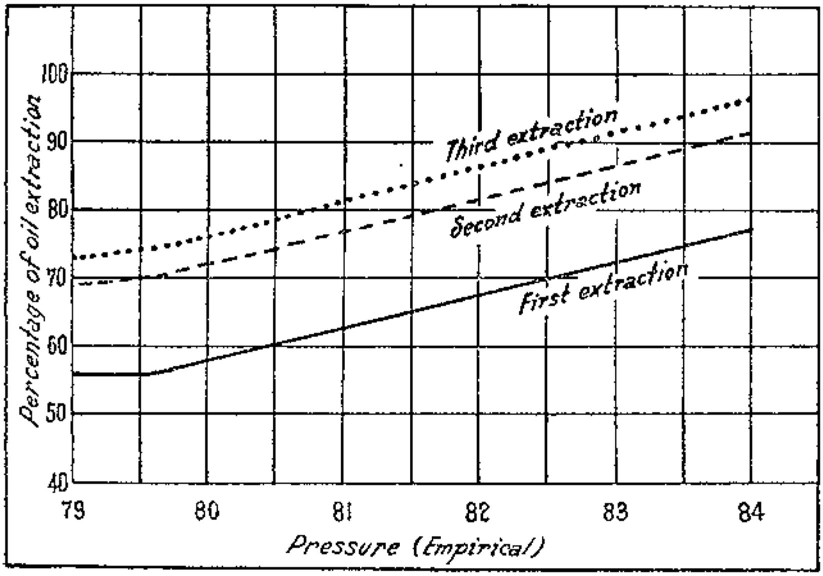

FIG. 1. Percentage of coconut oil extraction at various pressures.

The average percentage of water mixed with the fresh meat for the first pressing in Experiment 15 is 38 per cent instead of 50 per cent, and the percentage of water mixed with the pressed cake in the second and third extractions in Experiments 7 and 4 is 50 per cent instead of 100 per cent, but analysis of Table 3 shows that for approximate purposes this variation in the water of dilution can be allowed. The curves in text fig. 1 show that the relation between pressure and efficiency of oil extraction is linear, as shown definitely by the curve for the third extraction of oil, although this relation is not well defined in the first and second extractions. Text fig. 1 shows that with a pressure index of 84.5 it is possible to raise the efficiency of oil extraction after three pressings to 98 per cent.

Table 3 also shows that in order to get a coconut cake containing 16 per cent oil (dry basis) or less, a pressure index of at least 83 should be used together with little or no water of dilution in the first pressing (Experiment 9). A pressure index of 84 under various conditions of water dilution invariably gives an oil content of less than 16 per cent in the coconut cake after the third pressing (Experiments 12, 13, 14, and 20). Since the oil content of pressed coconut meat plays an important rôle in the salability of the cake, especially if it is to be used as human food and is to be stored for long periods of time, the use of the proper pressure for obtaining a cake of the allowable minimum oil content is important. On the other hand, if it should become commercially more practical to merely get as much oil from the fresh meat as possible, leaving a pressed coconut meat comparable to copra or desiccated coconut in oil content, it may be necessary merely to press the fresh meat once at pressure index 79 to 81; by this method the coconut cake will have an oil content of 48 to 57 per cent, and the percentage of oil extracted will be 56 to 67 per cent (Experiments 3 to 8).

Table 4 shows the effects of the other factors, such as speed of rollers and size of particles of the comminuted meat. With hand feeding, in which the meat is moved back and forth along the rollers, and in which no extra pressure on the feed is exerted, the speed of the rollers within the range employed has no appreciable effect on the time of extraction. However, a higher speed apparently increases the efficiency of oil extraction and decreases the oil content of the coconut cake (Experiments 18, 21, 22, and 23). This observation is subject to verification in later experiments, when the feed is mechanized.

Furthermore, a decrease in the size of the comminuted meat has clearly the effect of increasing the efficiency of oil extraction and of decreasing the oil content of the pressed coconut meat (Experiments 26 to 30). In fact, with a pressure index of 84, and with a roller speed of 3.6 R. P. M., decreasing the size of the particles to 5.9 by 1.8 by 0.9 mm not only gives an oil extraction efficiency of 96 per cent after three pressings, but also raises the efficiency of oil extraction even in the first pressing to 88 per cent. Again, however, the time of extraction does not seem to be appreciably altered by a change in particle size under the conditions of the experiment. The only drawback to a decrease in the size of particles of the comminuted meat seems to be that the tailings which pass through the roller screen but not through the rollers are slightly greater in quantity (Experiments 29 and 30); but this problem of reducing the tailings to a minimum may be solved mechanically.

Tables 1, 2, and 4 show the quality of the nuts, as described by the season during which they are picked or used, by their source, by their weight, by the weights of their meat and of their shells, and by the water content, oil content, and nonoil-solids content of the fresh meat. These characteristics will be discussed more fully in a later paper, but are given in this article in order to permit the making of calculations based on dried copra.

SUMMARY

1. Mixing water with coconut meat in the ratio by weight of 1 part of water to 2 parts of the fresh comminuted meat, or in the ratio of 1 part of water to 1 part of the pressed coconut meat gives mixtures with fluidities that seem to be best adapted for feeding in a roller press.

2. The size of the particles of comminuted meat affects the degree of oil extraction; the greater the size the less the efficiency of extraction, for a given set of rollers. As high as 88 per cent oil extraction can be obtained with the rollers used in one pressing if the meat is comminuted to an average size of 5.9 by 1.8 by 0.9 mm.

3. Under conditions of more or less continuous hand feeding a pressure that after three pressings produces a pressed coconut meat of around 50 per cent oil content (dry basis) will give an oil extraction efficiency of about 73 per cent. If this pressure is used only for one pressing, the oil content of the pressed meat obtained is about 55 per cent, corresponding to an oil extraction efficiency of around 56 per cent. On the other hand, a pressure that after three pressings produces a pressed coconut meat of around 16 per cent oil, will give an oil extraction efficiency of

around 96 per cent. If this latter pressure is used only for one pressing, the oil content of the pressed meat obtained is about 32 to 42 per cent, corresponding to an oil extraction efficiency of about 81 to 88 per cent. Within the range of pressures used the efficiency of oil extraction increases directly with pressure. The selection of the proper pressure to adopt will depend upon the use for which the pressed coconut meat is intended.

4. Without using a mechanical feeder in conjunction with the rollers (diameter, 10 inches; effective length, 24 inches), the capacity of these rollers can be made to vary from 5,500 to 20,000 nuts per day, depending upon whether a high or low oil content in the pressed meat is desired.

ILLUSTRATION

TEXT FIGURE

FIG. 1. Percentage of coconut oil extraction at various pressures.

CLAY-ASBESTOS SHINGLES

By GIL O. OPIANA
Of the Bureau of Science, Manila

TWO PLATES

This report contains an account of hand-made shingles from Philippine clay and asbestos. Manufacture of these shingles has been in progress at the Bureau of Science in recent years. These shingles are fireproof and make a handsome roof that renders the house cool and healthful.[1]

ANALYSIS OF RAW MATERIALS

The clay used in making these shingles was obtained from Molino, Cavite Province. Analysis of this clay is given in Table 1, and physical tests in Table 2. The usual standard chemical and physical methods were employed to obtain these data.

TABLE 1.—*Analysis of Molino clay.*

Constituent.	Per cent.
Silica (SiO_2)	51.00
Alumina (Al_2O_3)	17.05
Iron oxide (Fe_2O_3)	10.53
Lime (CaO)	1.40
Magnesia (MgO)	1.10
Alkalies (K_2O and Na_2O)	1.79
Loss on ignition	15.45

NOTE.—Analysis made by Mr. R. Oliver of the Bureau of Science.

TABLE 2.—*Physical tests of Molino clay.*

Moisture, per cent [a]	7.94
Water of plasticity, per cent	37.48
Slaking time, minutes	10
Volume shrinkage, per cent	39.03
Linear shrinkage	15.20
Tensile strength, pounds per square inch	8.50
Cross breaking	1.62
Drying qualities	Good
Absorption at 900° C.	17.35
Fusing point, °C. [b]	1,180

[a] The material was sieved through a 20-mesh sieve.

[b] Approximate.

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[1] Agricultural and Industrial Monthly (March, 1937) 12.

The asbestos used in this study was supplied by Mr. Baretto of Zambales Province. The chemical analysis of a representative sample is given in Table 3.

TABLE 3.—*Analysis of Philippine asbestos.*

Constituent.	Per cent.
Silica (SiO_2)	52.00
Alumina (Al_2O_3)	3.66
Iron oxide (Fe_2O_3)	3.84
Lime (CaO)	11.40
Magnesia (MgO)	23.61
Alkalies (K_2O and Na_2O)	0.52
Loss on ignition	4.10

NOTES.—The sample was obtained from Zambales Province. The analysis was made by Mr. Oliver of the Bureau of Science.

MIXTURE OF CLAY AND ASBESTOS

After a series of trial mixtures, the mixture adopted, which gave the least warping and cracking on drying and firing, consisted of 6 parts by oven-dry weight of asbestos and 4 parts by oven-dry weight of clay. The asbestos was first crushed in a wet pan [2] to a fine powder. After removal, a known weight of clay, usually 12 kilograms, freed from plant roots, pebbles, and other foreign material, was ground in the same way.

The asbestos was added little by little with continuous mixing. Water was then added in small portions until the right plasticity of the mixture was reached. The well-mixed mass was placed on a galvanized sheet in the drying shed covered with wet sacks and allowed to stand for at least 2 or 3 days to age.[3]

MOLDING, DRYING, AND FIRING

The tile was molded by hand. The mold, which was made of hardwood, was covered with a wet thick cloth (*maong*). Small pieces of the plastic mass were thrown to the two ends and crevice for the anchor. A slice larger than the mold was again thrown into the mold, covered with another piece of dry, thick cloth, and pounded with a wooden pestle all around to fill the mold completely. With a well-stretched galvanized wire tied to the two ends of a semicircular piece of bejuco (rattan) the excess was scraped off. To smooth the surface, a wet iron pallet was passed back and forth. The tile was placed upside down on dry boards with holes $\frac{7}{16}$ inch in diameter, at intervals of $2\frac{1}{2}$ inches, and smeared with powdered grog[4] to prevent the tiles from sticking and to reduce friction.[5] With a pointed $\frac{1}{16}$-inch copper wire a hole was bored through the middle for tying. Three tiles could be put on each board. The loaded boards were placed on racks inside the drying shed. Usually 6 to 7 days were required for slow drying of the tiles.

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[2] The Manufacture of Roofing Tiles. Bull. 11, 4th Series Geol. Survey of Ohio (1910) 230.

[3] A. B. Searle. A Rudimentary Treatise on the Manufacture of Bricks and Tiles. The Technical Press Ltd. 14th ed. (1936) 178.

To further dry the tiles, they were placed side by side in a perpendicular position on another wooden rack in the drying shed for a week or more. These air-dried tiles were fired in a down-draft horizontal kiln[6] with a capacity of 1,200 to 1,300 tiles to cone 08 (940° C).

The steps followed in firing were: smoking, decomposition, soaking, and cooling.[7] Dried pieces of bacauan were used as fuel and a kiln efficiency ranging from 95 per cent to 98 per cent was obtained.

TESTS

A comparison of the products obtained in this study and similar products made locally is given in Table 4.

TABLE 4.—*Moisture absorption of clay-asbestos shingles.*

Shingles.	Per cent.
Bureau of Science, hand-made	25.7–30.5
Torres High School, hand-made	26.7–30.8
Muntinlupa, hand-made	25.5–28.7
Ceramic Industries of the Philippines, machine-made	8.6–14.2

Table 4 shows the results obtained in absorption carried out in accordance with the methods of The American Society of Testing Materials.

The hand-made shingles have about the same percentages of water absorption, while the machine-made shingles have a very much lower percentage of absorption than the hand-made shingles. This marked difference is due to the high temperature of firing employed in the manufacture of machine-made shingles.

Table 5 shows the results obtained for modulus of rupture on a 7-inch span. The tests were made in the Division of Tests and Standards.

[4] Powdered bagasse ash was used.

[5] H. Wilson, Ceramics-Clay Technology. McGraw Hill Co. 1st ed. (1927) 130.

[6] E. Bourry. Treatise on Ceramic Industries. Scott, Greenwood & Co. (1901) 356.

[7] A. B. Searle. The Chemistry and Physics of Clays and other Ceramic Materials. Ernest Benn Ltd. (1924) 544.

TABLE 5.—*Modulus of rupture of clay-asbestos shingles.*

Shingles.	Pounds.
Bureau of Science, hand-made	125–185
Torres High School, hand-made	150–195
Muntinlupa, hand-made	125–175
Ceramic Industries of the Philippines, machine-made	115–190

Table 5 shows that there is no relation between percentage of absorption and modulus of rupture of shingles. The lowest figure obtained in the hand-made shingles was higher by 10 pounds than that of the machine-made shingles. The highest figure for hand-made shingles was 195 pounds, and for the machine-made shingles, 190 pounds.

SUMMARY

The method of making asbestos shingles is given. Manufacture of asbestos shingles by hand involves the use of simple equipment, so that it has possibilities as a home industry, especially in regions where raw materials and fuel are available.

Very little technique is required in the molding of tiles. An ordinary individual after a day or two of practice can do the work satisfactorily. In the Bureau of Science ordinary laborers molded the tiles, in Muntinlupa, prisoners, and in Torres High School, pupils.

There is no relation between percentage of absorption and modulus of rupture in shingles.

The percentage of absorption of hand-made shingles is about twice that of machine-made shingles.

The modulus of rupture for both machine-made and hand-made shingles is about the same.

ACKNOWLEDGMENT

To Doctor del Mundo of Ceramic Industries of the Philippines and Doctor Manlapas of the Bureau of Prisons, obligations are acknowledged for the generous supply of asbestos shingles used in this study.

ILLUSTRATIONS

PLATE 1

FIG. 1. Molding shingles by hand.
  2. Drying shelves.

PLATE 2

FIG. 1. Clay Asbestos shingles.
  2. House roofed with shingles.

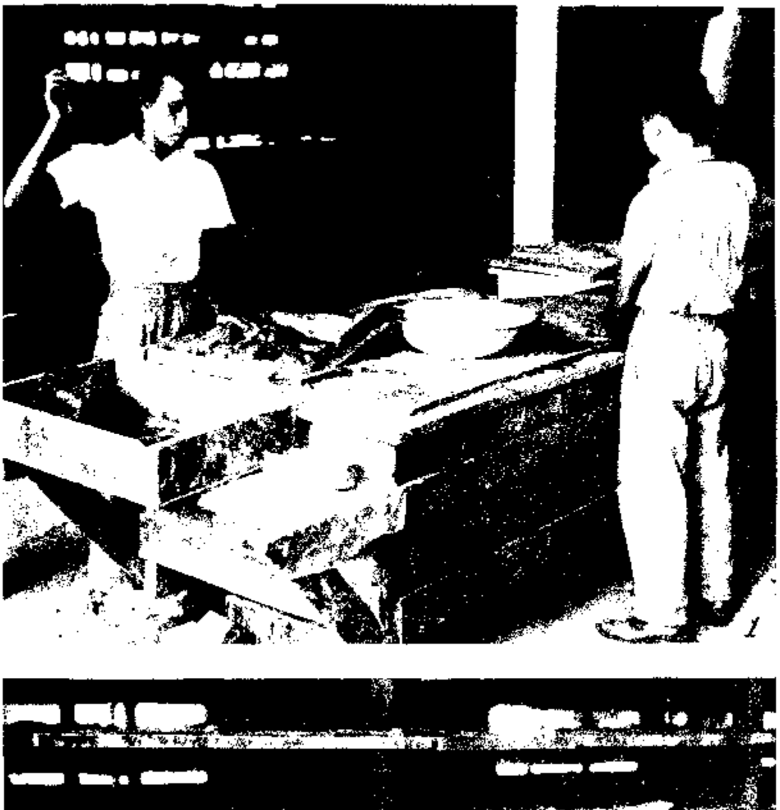
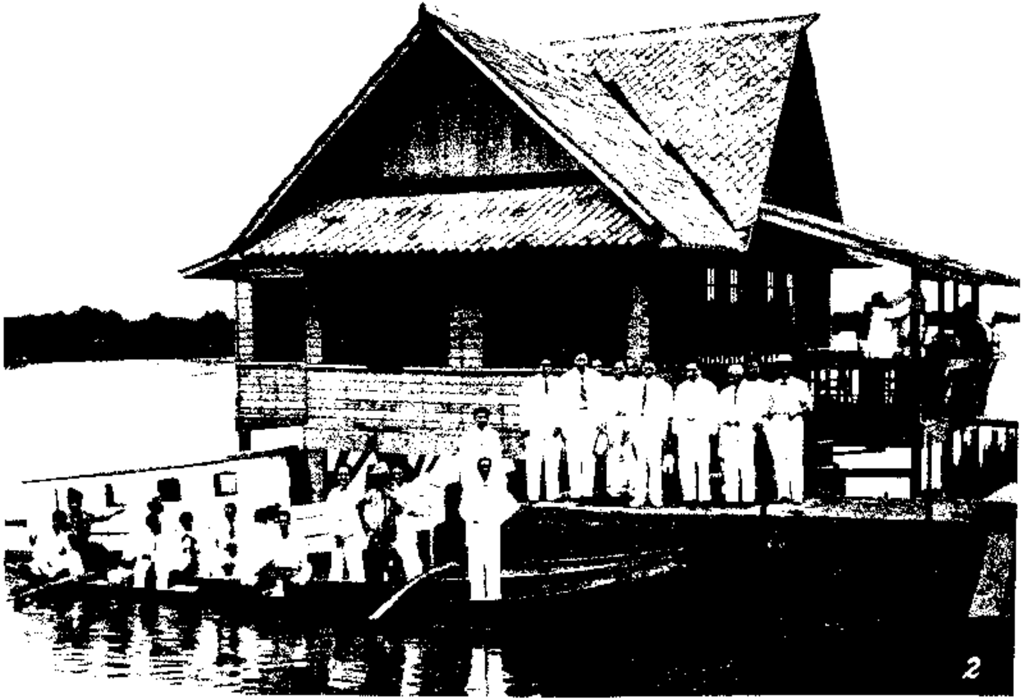


PLATE 1.

1



2

PLATE 2.

NEW OR NOTEWORTHY PHILIPPINE FUNGI, III

By JOSÉ M. MENDOZA and SIMEONA LEUS-PALO

Of the Natural History Museum Division, Department of Agriculture and Commerce, Manila

NINE TEXT FIGURES

The last paper under this title was published in 1932.[1] In the present contribution 10 species of the genus *Cercospora* are described as new. Twenty species previously described from extra-Philippine material are for the first time reported from the Archipelago, 10 of these being of the genus *Cercospora,* the rest of the family Agaricaceæ. All the type species and other specimens have been deposited in the Philippine National Herbarium of the Natural History Museum, Manila.

SCOLECOSPORÆ

Genus CERCOSPORA Fressenius

CERCOSPORA ATHYRII Mendoza sp. nov. Text fig. 1.

Maculis amphigenis, plus minusve indefinite sed pluscule similaris, irregulariter, 1 ad 8 mm in diametro, saepe depressis ad maturescens. Conidiophoris abundantis, e basi stromatica. rumpens per aperti, obscuris olivaceis vel griseolis, tandem pallidis vel hyalinis ad apicem, unicus vel multi-septatis, denticulatis circa apice, 33 ad 104 μ × 3.6 ad 4.8 μ. Conidiis abundantis, maxime angustis, obsclavatis, acicularis vel falcatis, multi-septatis, 24 ad 90 μ × 3 ad 5 μ.

Spots amphigenous, more or less indefinite but more inclined to be irregularly circular, 1 to 8 mm in diameter, oftentimes sunken at maturity. Conidiophores abundant, stromatic at base, rupturing from stomata, dark olive to grayish, becoming pale to hyaline toward apex, 1- to many-septate, denticulate near the end, 33 to 104 μ long, 3.6 to 4.8 μ broad. Conidia abundant, very narrow, obclavate, needle-shaped to scythe-shaped or curved, many-septate, 24 to 90 μ long, 3 to 5 μ broad.

LUZON, Manila, *Bur. Sci. 55483 Mendoza* (type in Philip. Nat. Herb.), on leaves of *Athyrium esculentum* Copel.

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[1] Mendoza, J. M., New or noteworthy Philippine Fungi. II. Philip. Journ. Sci. 49 (1932) 185–196.

There is a close resemblance between this fungus and *C. beticola* Sacc. The conidiophores of both species are reticulate, having bent knees and scars on the upper portion or near the apex. They are stromatic at the base. The conidiophores of *C. athyrii*, however, are much longer; moreover, the spores of this fungus are vacuoled and granular, while those of *C. beticola* are hyaline and simple.

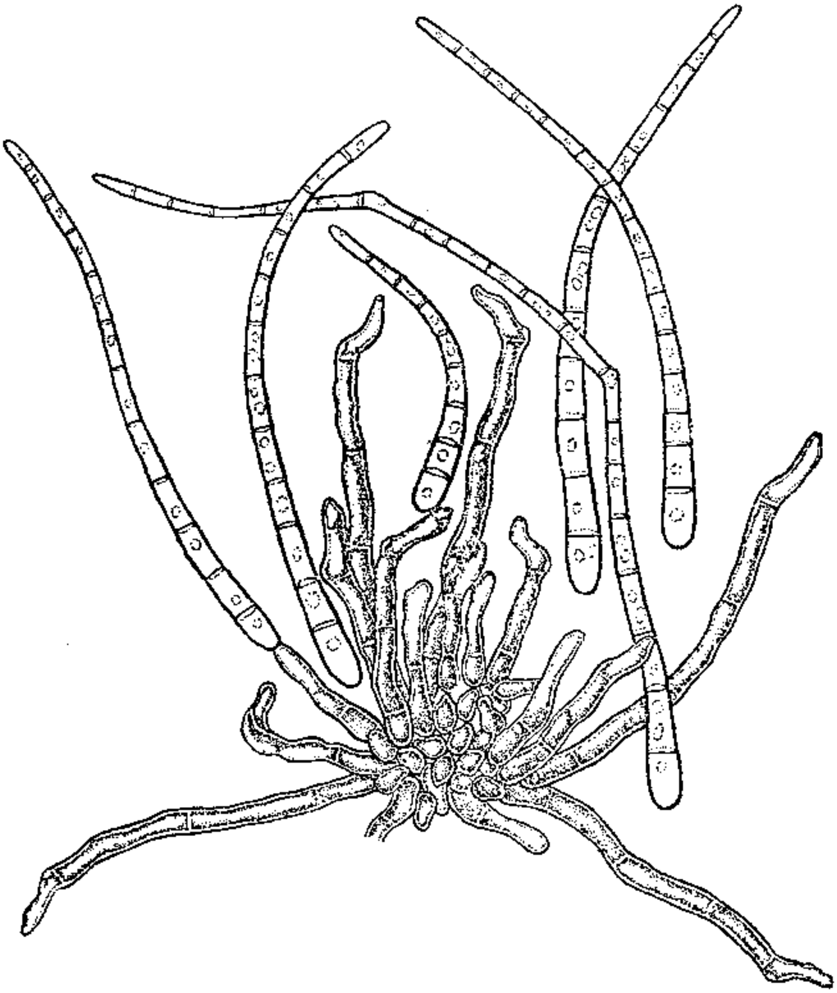

FIG. 1. *Cercospora athyrii* Mendoza sp. nov.

CERCOSPORA BALSAMINAE Mendoza sp. nov. Text fig. 2.

Maculis amphigenis irregulariter rotundatis vel indefinitis formis, disseminatis, saepe confluentis, depressis, zona fusca cir-

cumdatis aetatis, pallidis brunneis in centrum, obscuris brunneis centrifugalis, 1 ad 8 mm in diametro, cum maxime area quam alicui confluentis, saepe totus centrum maculis disrumpens reliqui perforati. Conidiophoris confluentis, pallidis olivaceis griseis, tandem pallidis vel casi hyalinis, longis distans-septatis, subdenticulatis ad vel circa nodus, 60 ad 140 μ × 4 ad 5 μ.

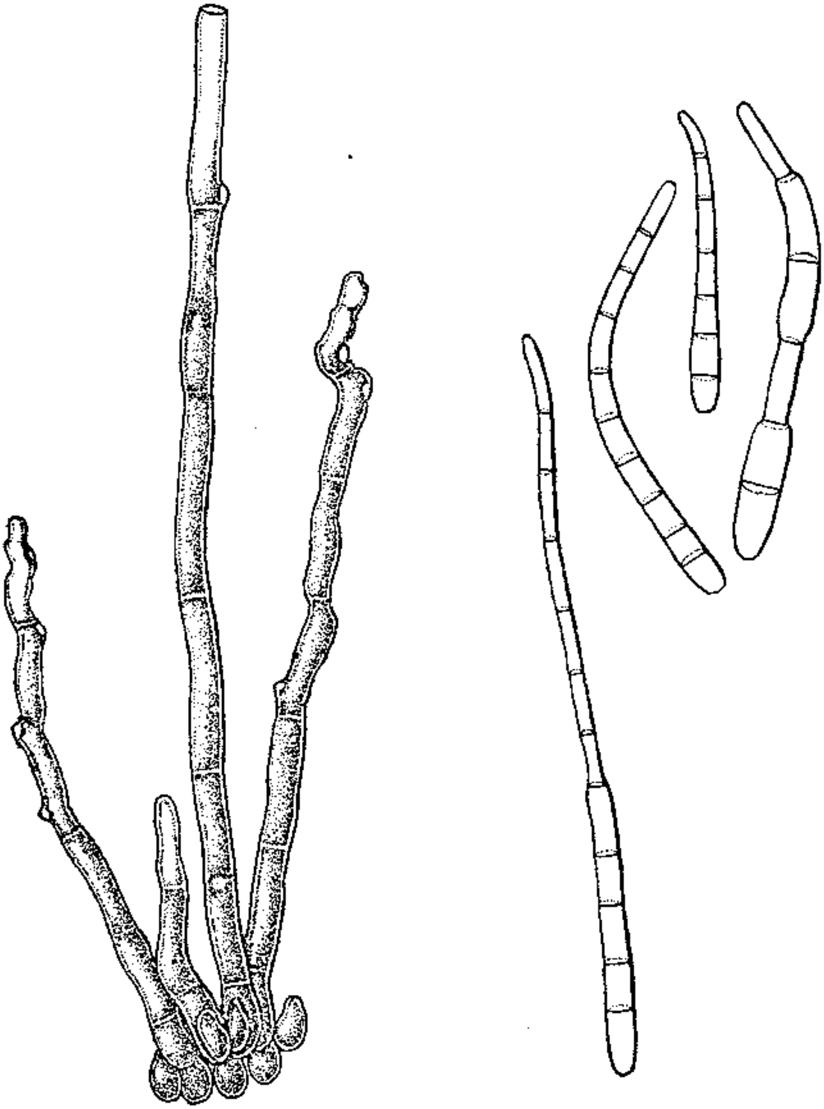

FIG. 2. *Cercospora balsamimae* Mendoza sp. nov.

Conidiis multi-septatis, rotundatis e basi et apice gradatim attenuatis ad apicem, 44 ad 140 μ × 3.5 to 4.5 μ.

Spots amphigenous, irregularly circular to indefinite in form, scattered, oftentimes coalescing, sometimes covering larger areas, sunken, with concentric ring formations in age, light brown at center, dark brown around margin, 1 to 8 mm in diameter, spots often falling off leaving shot holes. Conidiophores in tufts, pale olive-gray becoming pale to almost hyaline toward apex, distant-septate, provided with knees and scars at or near nodes, 60 to 140 μ long, 4 to 5 μ broad. Conidia very long, obclavate, hyaline, sometimes constricted, many-septate, round at base and at apex, gradually tapering toward end, 44 to 140 μ long, 3.5 to 4.5 μ broad.

LUZON, Laguna Province, Los Baños, *Bur. Sci. 55508 Mendoza* (type in Philip. Nat. Herb.), on leaves of *Impatiens balsamina* Linn.

This fungus somewhat resembles *C. atro-cincta* Ell. and Wolf, both having flexuous and reticulate conidiophores. The reticulations are located on the upper portion near the apex. The two fungi are more or less stromatic at the base. They differ, however, in the characteristics of the spores. The conidia of *C. atro-cincta* are larger than those of *C. balsaminae.* Another difference is that the conidia of *C. balsaminae* are often constricted, while those of *C. atro-cincta* are hyaline and simple.

CERCOSPORA CARTHAMI Mendoza sp. nov. Text fig. 3.

Maculis amphigenis, subrotundatis, obscuris brunneis, superne cum griseis olivaceis, 5 ad 10 mm in diametro, interdum confluentis, zona fusca circumdatis, centro depressis. Conidiophoris abundantis, fasciculatis, simplicis, distinctis septatis, pallidis olivaceis ad centrum tandem griseis ad apicem, 38 ad 175 μ × 5 ad 6 μ. Conidiis hyalinis, obclavatis vel cylindraceis, 5- ad 10- septatis, 48 ad 287 μ × 4 ad 6 μ.

Spots amphigenous, somewhat round, dark brown, dotted with little gray freckles, 5 to 10 mm in diameter, sometimes fusing, provided with concentric markings, sunken at center. Conidiophores abundant, in bundles, simple, distinctly-septate, light grayish olive at center, becoming pale smoke-gray toward apex, 38 to 175 μ long, 5 to 6 μ broad. Conidia hyaline, obclavate to cylindric, 5- to 10-septate, 48 to 287 μ long, 4 to 6 μ broad.

LUZON, Rizal Province, Mariquina, *Bur. Sci. 55295* (type in Philip. Nat. Herb.), *55465 Mendoza,* on leaves of *Carthamum tinctorium* Linn.

This species approaches *C. cucurbitae* Ell. and Ev. in many respects. Both have erect and distinctly septate conidiophores, which are blunt at the end. The difference lies in the conidia of *C. cucurbitae* being vacuoled and granular, while those of *C. carthami* are neither.

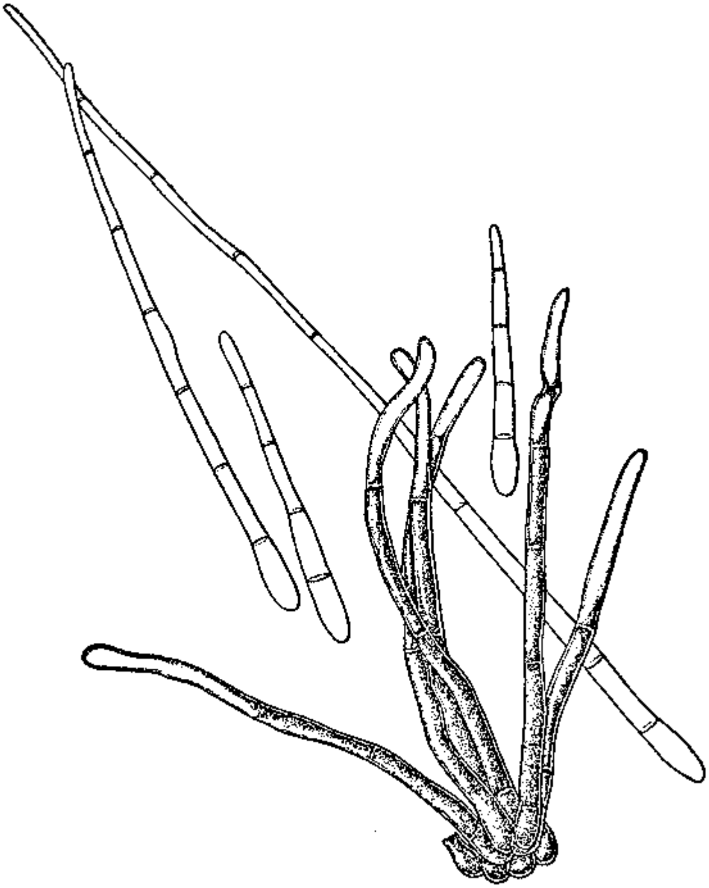

FIG. 3. *Cercospora carthami* Mendoza sp. nov.

CERCOSPORA JACOBINAE Mendoza sp. nov. Text fig. 4.

Maculis amphigenis, sed plerumque plus minusve rotundatis, 3 ad 12 mm in diametro, obscuris brunneis tandem multis albidis ad marginem. Fungus fasciculatus, abundans, amphigenus.

This species approaches *C. cucurbitae* Ell. and Ev. in many respects. Both have erect and distinctly septate conidiophores, which are blunt at the end. The difference lies in the conidia of *C. cucurbitae* being vacuoled and granular, while those of *C. carthami* are neither.

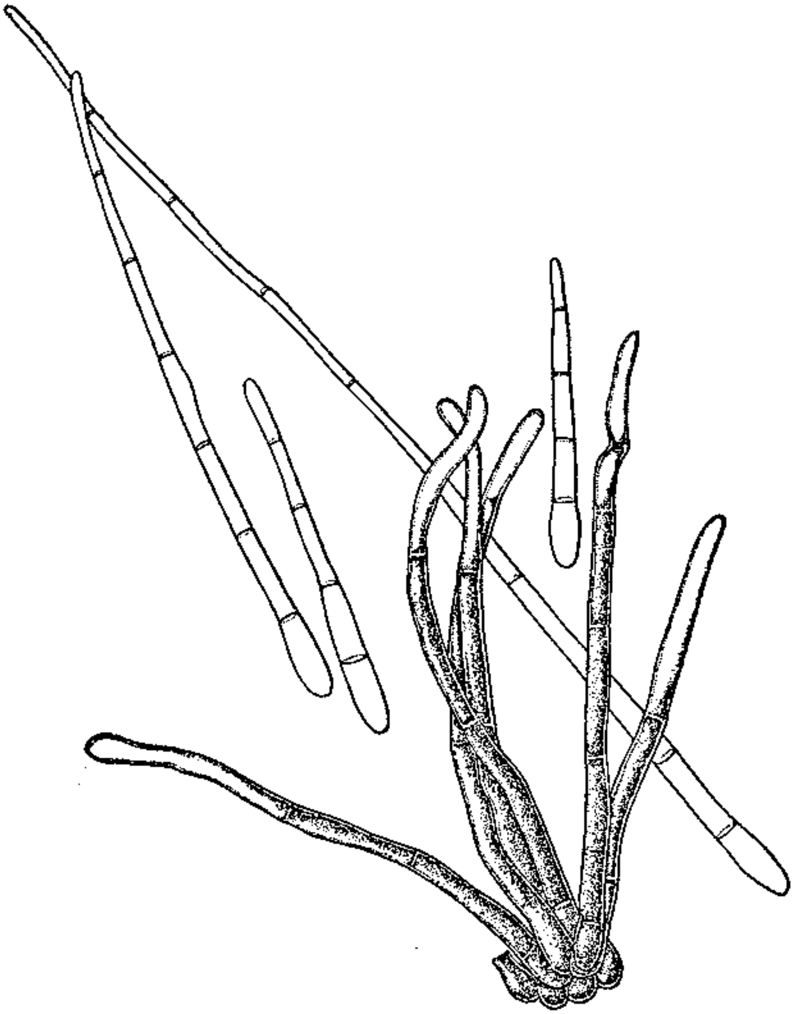

FIG. 3. *Cercospora carthami* Mendoza sp. nov.

CERCOSPORA JACOBINAE Mendoza sp. nov. Text fig. 4.

Maculis amphigenis, sed plerumque plus minusve rotundatis, 3 ad 12 mm in diametro, obscuris brunneis tandem multis albidis ad marginem. Fungus fasciculatus, abundans, amphigenus.

Conidiophoris obscuris olivaceis, e basi stromatica, erectis, flexuus, multi-septatis, subdenticulatis ad vel circa nodo 30 ad 150 µ 3 ad 6.5 µ. Conidiis aciculatis, cylindraceis, saepe curvatis circa apicem, multi-septatis, hyalinis, obclavatis, 30 ad 75 µ × 3 ad 4.5 µ.

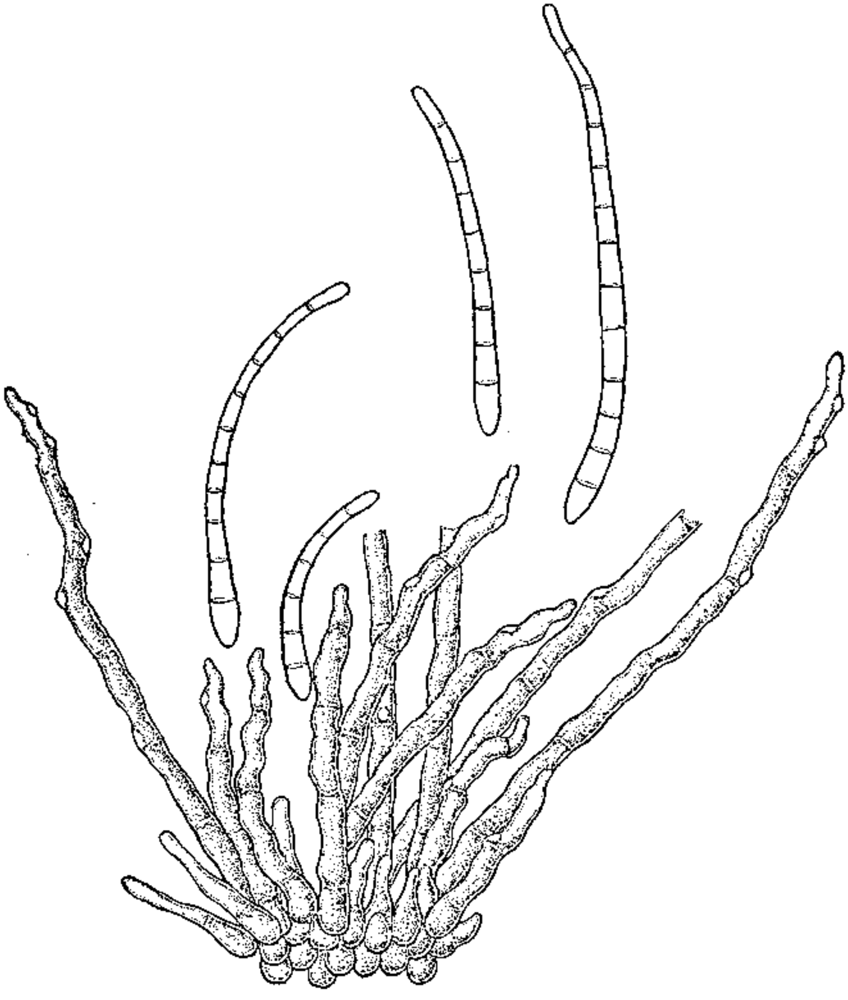

FIG. 4. *Cercospora jacobinae* Mendoza sp. nov.

Spots amphigenous, irregular but generally more or less circular in shape, 3 to 12 mm in diameter, dark brown becoming lighter toward margin. Fungus in tufts, abundant, amphigenous. Condidiophores dark olive, stromatic at base, erect, winding, many-septate, subdenticulate, especially at or near septation, 30 to 150 µ long, 3 to 6.5 µ broad. Conidia needle-shaped,

cylindric, often curved near end, many-septate, hyaline, 30 to 75 μ long, 3 to 4.5 μ broad.

LUZON, Manila, *Philip. Nat. Herb. 7124 Mendoza* (type in Philip. Nat. Herb), on leaves of *Jacobina carnea* Nichols.

At a glance *C. jacobinae* and *C. beticola* Sacc. look alike in many respects, both having flexuous and reticulated conidiophores. The conidia and conidiophores of *C. jacobinae*, however, are larger.

CERCOSPORA MALVASTRI Mendoza sp. nov. Text fig. 5.

Maculis plus minusve circularis, parvis, subdepressis, brunneis vel obscuris brunneis, amphigenis, raro coalescens, genera-

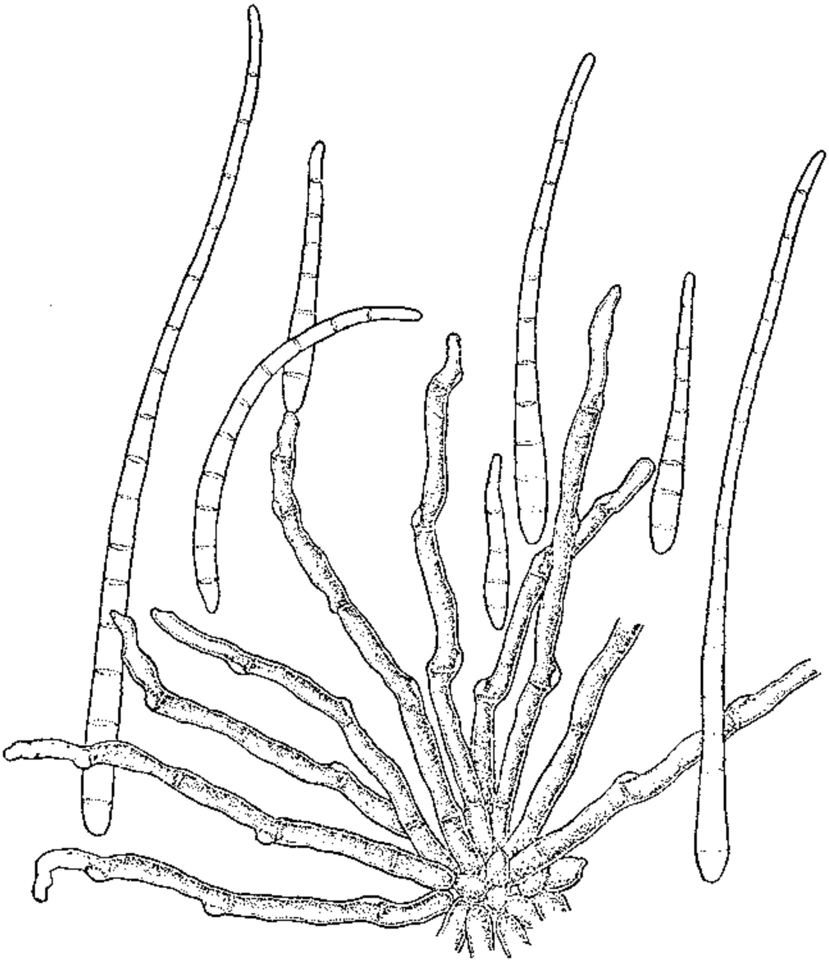

FIG. 5. *Cercospora malvastri* Mendoza sp. nov.

tim minus quam 1 mm ad raro 2 mm in diametro. Conidiophoris numerosis, plus minusve e basi substromatica, pallidis olivaceis, tandem olivaceis ad subhyalinis ad apicem, reticulatis, flexuus, multi-septatis, 18 ad 114 μ × 4.2 ad 5 μ. Conidiis numerosis, hyalinis, aliquot and multi-septatis, obclavatis, non rotundatis ad apicem, subcontractura ad apicem, rectis, interdum curvatis, 18 ad 123 μ × 3 ad 3.6 μ.

Spots more or less circular, small, nearly sunken, brown to dark brown, amphigenous, seldom coalescent, generally less than 1 mm to nearly 2 mm in diameter. Conidiophores numerous, substromatic at base, light olive, becoming pale to nearly hyaline towards end, reticulate, flexuous, many-septate, 18 to 114 μ long, 4.2 to 5 μ broad. Conidia numerous, hyaline, several to many-septate, obclavate, not round at base, somewhat tapering towards end, straight, sometimes curved, 18 to 123 μ long, 3 to 3.6 μ broad.

LUZON, Manila, *Bur. Sci. 55417 Mendoza* (type in Philip. Nat. Herb.), on leaves of *Malvastrum coromandelinum* (Linn.) Gareke.

This fungus resembles *C. capsici* Heald and Wolf in many respects. The conidiophores of the two species are numerous, reticulate, and flexuous. The conidiophores, of *C. capsici*, however, are more winding and much longer than those of *C. malvastri;* also *C. capsici* is more stromatic at the base than *C. malvastri.*

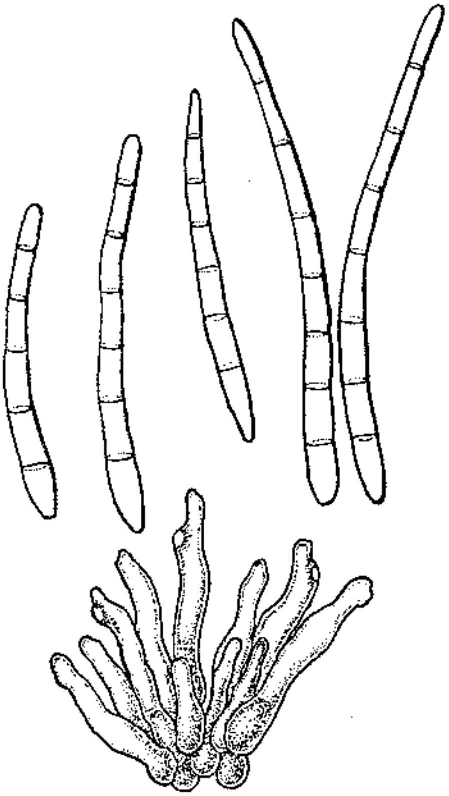

FIG. 6. *Cercospora merremiae* Mendoza sp. nov.

CERCOSPORA MERREMIAE Mendoza sp. nov. Text fig. 6.

Maculis amphigenis, maxime irregulariter formis, 3 ad 10 mm in diametro, depressis ad centrum dum elevatis ad marginem, obscuris brunneis vel maxime obscuris. Conidiophoris confluentis, pallidis olivaceis, plus minusve e basi stromatica, non- vel 1-septate, reticulatis ad apicem, 15 ad 36 μ × 3 ad 3.6 μ. Conidiis subidem coloris conidiophoris, interdum plus illustris, acicularis vel fuscidis, saepe curvatis, 30 ad 81 μ × 3 ad 4.5 μ.

Spots amphigenous, very irregularly shaped, 3 to 10 mm in diameter, sunken at center, elevated at margin, dark brown to very dark brown. Conidiophores in tufts, pale olive, more or less stromatic at base, 0- to 1-septate, with usual scars near end, 15 to 36 μ long, 3 to 3.6 μ broad. Conidia almost of same color as conidiophores, sometimes lighter, needle-shaped to spindle-shaped, 30 to 81 μ long, 3 to 4.5 μ broad.

LUZON, Manila, *Philip. Nat. Herb. 7122* Mendoza (type in Philip. Nat. Herb.), on leaves of *Merremia gemella* (Burm. f.) Hallier f.

This fungus is somewhat similar to *C. henningsii* Allesch. in many respects. Both species are stromatic at the base. The conidiophores of the two fungi are similar in shape and both are nonseptate, although *C. merremiae* is sometimes 1-septate. The conidia of the two species are similar, being nearly cylindrical. The spores of *C. merremiae*, however, are much larger.

CERCOSPORA MOMORDICAE Mendoza sp. nov. Text fig. 7.

Maculis amphigenis, irregulariter rotundatis vel indefinite formis, disseminatis, depressis, zona fusca circumdatis aetatis, pallidis brunneis in centro, brunneis centrifugalis, 1 ad 12 mm in diametro, saepe maculis confluens formans maxime grandis areae. Conidiophoris fasciculatis vel caespitosis, flexuus, pallidis olivaceis griseis, tandem griseis ad apicem, denticulatis ad vel circa nodis, interdum ramosis, distinctis septatis, 24 ad 127 μ × 4 ad 5 μ. Conidiis maxime longis, interdum ad septa constrictis, hyalinis, multi-septatis, e basi rotundatis, gradatim atenuatis ad apicem, obtusatis e apice, 44 ad 450 μ × 3.5 ad 5.5 μ.

Spots amphigenous, irregularly circular to no definite form, scattered, sunken, with concentric ring formations in age, pale brown at center, brown around margin, 1 to 12 mm in diameter, spots often coalescing to form larger areas. Conidiophores in clusters or in tufts, flexuous, pale olive-gray becoming gray toward apex, provided with knees and scars on or near nodes, sometimes branching, distinctly-septate, 24 to 127 μ long, 4 to 5 μ broad. Conidia very long, obclavate, hyaline, many-septate, sometimes constricted at septa, round at base, tapering toward end, 44 to 450 μ long, 3.5 to 5.5 μ broad.

LUZON, Manila, *Bur. Sci. 55334* (type in Philip. Nat. Herb.), *55372 Mendoza*, on leaves of *Momordica charantia* Linn.

This fungus somewhat resembles *C. beticola* Sacc., both having flexuous and reticulated conidiophores with a slightly stromatic base. The difference lies in that the conidiophores of *C. momordicae* are sometimes branching, while those of *C. beticola* are never branching. The conidia of *C. momordicae* are very much larger than those of *C. beticola*. *C. brassicicola* P. Henn. is another fungus that resembles *C. momordicae*, because of the characteristic reticulation of the conidiophores. The conidiophores of *C. brassicicola*, however, never branch out.

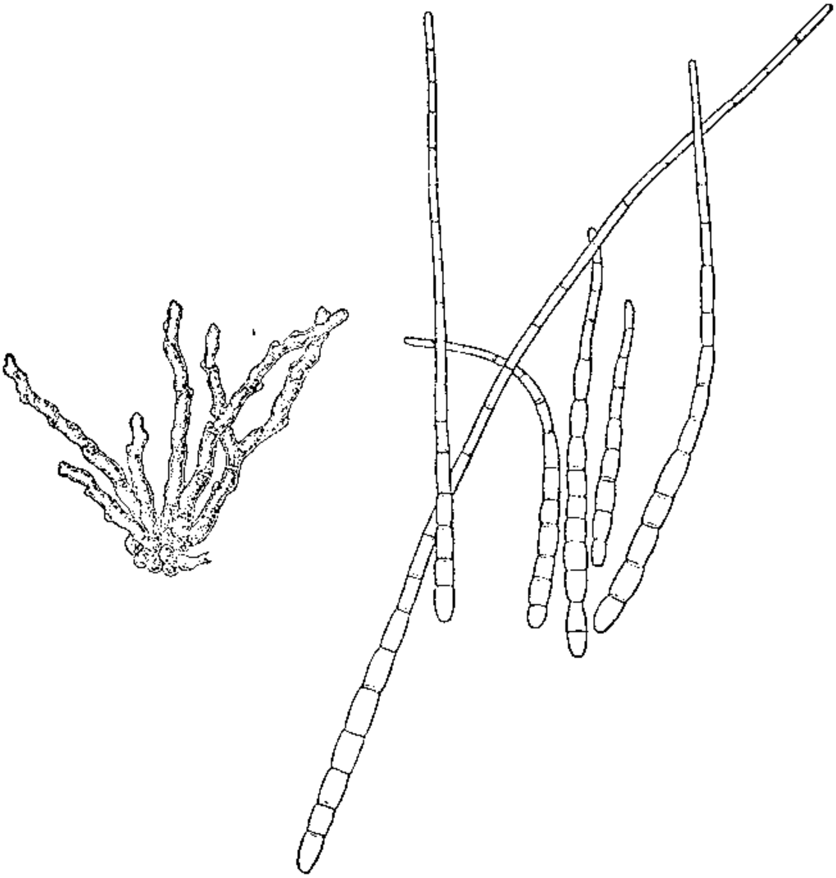

FIG. 7. *Cercospora momordicae* Mendoza sp. nov.

CERCOSPORA OPERCULINAE Mendoza sp. nov. Text fig. 8.

Maculis amphigenis, circularis, pallidis griseis vel viridulis, dispergens, 1 ad 7 mm in diametro. Conidiophoris caespitosis,

fasciculatis, suberectis, reticulatis e superiore parte, septatis, obscuris griseis, tandem pallidis ad apicem, 76.5 ad 109 μ × 3.8 ad 4.5 μ. Conidiis hyalinis, granularis, obclavatis, acicularis, interdum falcatis, multi-septatis, 60 ad 85 μ × 3.5 ad 4.5 μ.

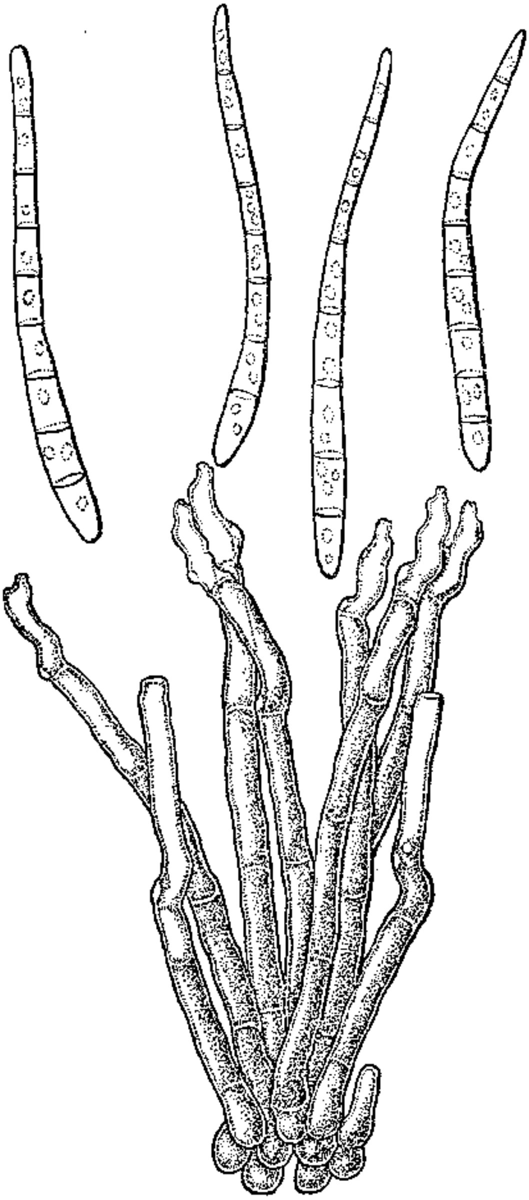

FIG. 8. *Cercospora operculinae* Mendoza sp. nov.

Spots amphigenous, circular, light gray to greenish, scattered, 1 to 7 mm in diameter. Conidiophores cæspitose, fasciculate, nearly erect, reticulate especially on upper portion, septate, dark gray, becoming pale toward end, 76.5 to 109 µ long, 3.8 to 4.5 µ broad. Conidia hyaline, granular, obclavate, needle-shaped, cylindric, sometimes curved, many-septate, 60 to 85 µ long, 3.5 to 4.5 µ broad.

LUZON, Rizal Province, Fort Wm. McKinley, *Phil. Nat. Herb. 7125* (type in Philip. Nat. Herb.), *7126 Mendoza*, on leaves of *Operculina bufalina* (Lour.) Hallier f.

Some characteristics of this fungus are similar to those of *C. jacobinae* Mendoza. Both species have that peculiar winding of the conidiophores, especially on the upper portion near the apex. *C. jacobinae*, however, is more stromatic at the base than *C. operculinae;* also the conidia of this fungus are vacuoled and granular, while those of *C. jacobinae* are hyaline and simple.

CERCOSPORA PELARGONII Mendoza sp. nov. Text fig. 9.

Maculis rotundatis, minimi vel grandis irregularis maculis, amphigenis, depressis, pallidis brunneis ad centro, rubricosis brunneis ad margine, 1 ad 15 mm in diametro. Conidiophoris caespitosis, erectis, reticulatis, flexuus, plus minusve e basi stromatica, aliquot distans-septatis, obscuris olivaceis, tandem pallidis et aculatis ad apicem, 42 ad 96 µ × 3.9 ad 5.7 µ. Conidiis numerosis, obclavatis, fuscidis, interdum curvatis, multi-septatis, hyalinis, obtusatis ad apicem, 24 ad 172 µ × 2.7 ad 3.6 µ.

Spots round, very small to large, almost irregular blotches, amphigenous, sunken, light brown at center, reddish brown at margin, 1 to 15 mm in diameter. Conidiophores in tufts, reticulate, flexuous, more or less stromatic at base, several distant-septate, dark-olive, becoming lighter toward apex and a little pointed at end, 42 to 96 µ long, 3.9 to 5.7 µ broad. Conidia numerous, obclavate, spindle-shaped, sometimes curved, many-septate, hyaline, obtuse on both ends, 24 to 172 µ long, 2.7 to 3.6 µ broad.

LUZON, Manila, *Bur. Sci. 55132* (type in Philip. Nat. Herb.), *55500 Mendoza*, on leaves of *Pelargonium radula* (Cav.) L'Herit.

This fungus resembles *C. beticola* Sacc. in many respects. The conidiophores of the two fungi are cæspitose, fasciculate, flexuous and more or less stromatic at the base. The difference lies in that the conidiophores of *C. pelargonii* are much larger and generally broader. The conidiophores of *C. beticola* are much more winding than those of *C. pelargonii.*

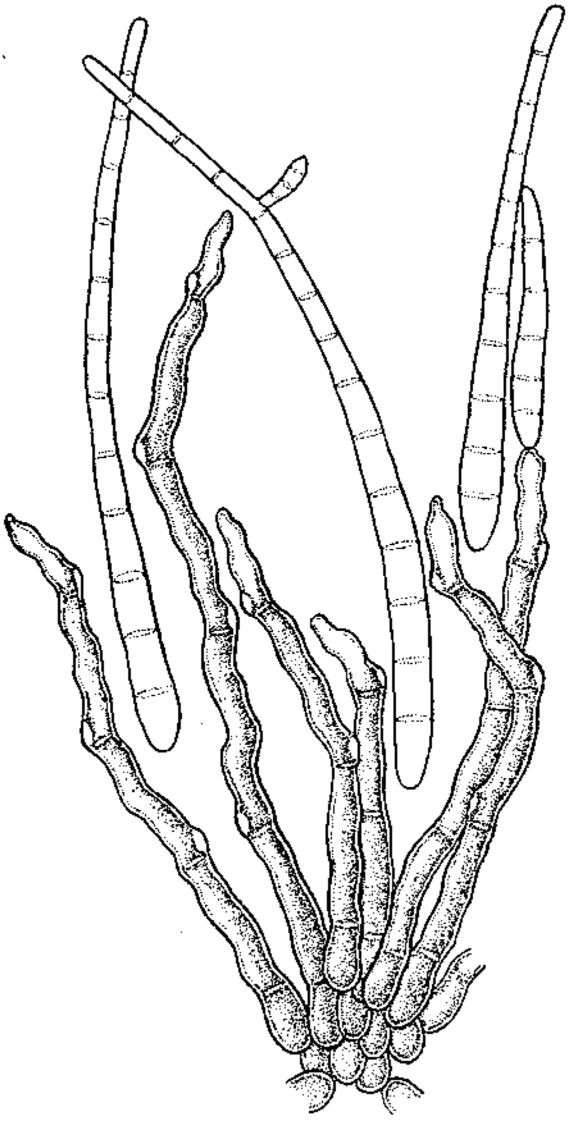

FIG. 9. *Cercospora pelargonii* Mendoza sp. nov.

CERCOSPORA ATRO-CINCTA Heald and Wolf.

Cercospora atro-cincta HEALD and WOLF, Mycologia 3 (1911) 15; SACCARDO, Syll. Fung. 25 (1931) 873.

LUZON, Manila, *Bur. Sci. 55520 Mendoza,* on leaves of *Zinnia elegans* Jacq.

CERCOSPORA ASTERATA Atkinson.

Cercospora asterata ATKINSON, Cerc. Alab. (1891) 18; SACCARDO, Syll. Fung. 10 (1892) 627.

LUZON, Manila, *Bur. Sci. 55502 Mendoza,* on leaves of *Aster* sp.

CERCOSPORA CHRYSANTHEMI Heald and Wolf.

Cercospora chrysanthemi HEALD and WOLF, Mycologia 3 (1911) 15; SACCARDO, Syll. Fung. 25 (1931) 871.

LUZON, Manila, *Bur. Sci. 55522 Mendoza,* on leaves of *Chrysenthemum* sp.

CERCOSPORA CUCURBITAE Ellis and Everhart.

Cercospora cucurbitae ELLIS and EVERHART, Journ. Mycol. 4 (1888) 3; SACCARDO, Syll. Fung. 10 (1892) 634.

LUZON, Manila, *Bur. Sci. 55353, 55494 Mendoza,* on leaves of *Cucurbita pepo* Linn.

CERCOSPORA DALEAE Ellis Kellerman.

Cercospora daleae ELLIS and KELLERMAN, Journ. Mycol. 4 (1888) 6; SACCARDO, Syll. Fung. 10 (1892) 622.

LUZON, Manila, *Philip. Nat. Herb. 2978 Mendoza,* on leaves of *Dalea* sp.

CERCOSPORA EUCALYPTI Cooke and Massee.

Cercospora eucalypti COOKE and MASSEE, Aust. Fungi (1892) 379; SACCARDO, Syll. Fung. 10 (1892) 644.

LUZON, Manila, *Bur. Sci. 55491 Mendoza,* on leaves of *Eucalyptus* sp.

CERCOSPORA HELIANTHI Ellis and Everhart.

Cercospora helianthi ELLIS and EVERHART, Journ. Mycol. 3 (1887) 20; SACCARDO, Syll. Fung. 10 (1892) 628.

LUZON, Mountain Province, Baguio, *Bur. Sci. 55235 Mendoza,* on leaves of *Helianthus cucumerifolius* Torr. and Gray.

CERCOSPORA HYDRANGEANA Tharp.

Cercospora hydrangeana THARP, Myc. 9 (1917) 110.

LUZON, Mountain Province, Baguio, *Bur. Sci. 55236 Mendoza,* on leaves of *Hydrangea ortensia* Sieb.

CERCOSPORA SORGHI Ellis and Everhart.

Cercospora sorghi ELLIS and EVERHART, Journ. Mycol. 5 (1887) 15; SACCARDO, Syll. Fung. 10 (1892) 656.

LUZON, Rizal Province, Mariquina, *Bur. Sci. 55232, 55328 Mendoza,* on leaves of *Zea mays* Linn.

CERCOSPORA PACHYPUS Ellis and Everhart.

Cercospora pachypus ELLIS and EVERHART, Journ. Mycol. 3 (1887) 104; SACCARDO, Syll. Fung. 10 (1892) 628.

LUZON, Mountain Province, Trinidad, *Bur. Sci. 55541 Mendoza,* on leaves of *Helianthus annuus* Linn.

AGARICACEÆ

Genus CANTHARELLUS Jussieu

CANTHARELLUS CINEREUS Fries.

Cantharellus cinereus FRIES, Epicr. Syst. Myc. (1836) 320; Hym. Eur. (1870) 458; SACCARDO, Syll. Fung. 5 (1887) 490; MAUBLANC, Les Champignons de France 2 (1926) 166; BRESADOLA, Icon. Myc. 10 (1927) 480.

LUZON, Tayabas Province, Mount Kamates, *Philip. Nat. Herb. 2882 Edaño:* Rizal Province, Alabang, *Philip. Nat. Herb. 7038 Mendoza:* Laguna Province, Los Baños, *Philip. Nat. Herb. 7054, 7057 Mendoza.*

Genus CLITOCYBE Fries

CLITOCYBE DEALBATA Sowerby.

Clitocybe dealbata SOWERBY in Fries, Epicr. Syst. Myc. (1836) 63. Hym. Eur. (1878) 88; SACCARDO, Syll. Fung. 5 (1887) 157; BRESADOLA, Icon. Myc. 3 (1927) 146.

LUZON, Tayabas Province, Mount Kamates, *Philip. Nat. Herb. 2840 Edaño.*

Genus FLAMMULA Fries

FLAMMULA DECUSSATA Fries.

Flammula decussata FRIES, Epicr. Syst. Myc. (1836) 185; Hym. Eur. (1878) 246; SACCARDO, Syll. Fung. 5 (1887) 816; BRESADOLA, Icon. Myc. 16 (1930) 771.

LUZON, Tayabas Province, Mount Demasengay, *Philip. Nat. Herb. 2888 Edaño.*

Genus MARASMIUS Fries

MARASMIUS FULVO-BULBILLOSUS R. Fries.

Marasmius fulvo-bulbillosus R. FRIES in Bresadola, Icon. Myc. 11 (1929) 501.

Marasmius canticinalis FRIES, Epicr. Syst. Myc. (1836) 536.

LUZON, Laguna Province, Siniloan, *Philip. Nat. Herb. 7120 Capco.*

MARASMIUS OREADES Bolton.

Marasmius oreades BOLTON in Fries, Epicr. Syst. Myc. (1836) 375; Hym. Eur. (1878) 467; SACCARDO, Syll. Fung. 5 (1887) 510; BRESADOLA, Icon. Myc. 10 (1929) 490.

LUZON, Pangasinan Province, Binalonan, *Philip. Nat. Herb. 7061 Mendoza:* Tayabas Province, Mount Biga, *Philip. Nat. Herb. 7118 Edaño.*

Genus OMPHALIA Persoon

OMPHALIA GERARDIANA Peck.

Omphalia gerardiana PECK, N. Y. State Mus. Rept. 26 (1874) 54; 45 (1893) 37; FARLOW, Icones Farlowianae (1929) 4.

LUZON, Tayabas Province, Mount Kamates, *Philip. Nat. Herb. 2847 Edaño.*

OMPHALIA VENTOSA Fries.

Omphalia ventosa FRIES, Epicr. Syst. Myc. (1836) 120; Hym. Eur. (1878) 155; SACCARDO, Syll. Fung. 5 (1887) 309; BRESADOLA, Icon. Myc. 6 (1928) 256.

LUZON, Tayabas Province, Tignoan, *Philip. Nat. Herb. 7109 Edaño.*

Genus PLEUROTUS Fries

PLEUROTUS FUSCUS (Batt.) Bresadola.

Pleurotus fuscus (Batt.) BRESADOLA, Icon. Myc. 6 (1929) 286.

Agaricus eryngii DE CANDOLLE in Fries, Epicr. Syst. Myc. 1 (1836) 84; Hym. Eur. (1878) 171; SACCARDO, Syll. Fung. 5 (1887) 347.

Clitocybe cardarella FRIES, Hym. Eur. (1887) 80.

LUZON, Tayabas Province, Mount Kamates, *Philip. Nat. Herb. 2844 Edaño.*

Genus RUSSULA Persoon

RUSSULA CARNICOLOR Bresadola.

Russula carnicolor BRESADOLA in Rea, Brit. Basid. (1922) 477; Icon. Myc. 9 (1929) 427.

Russula lilacea QUÉLET in Saccardo, Syll. Fung. 5 (1887) 465.

Russula lilacea var. *carnicolor* BRESADOLA in Saccardo, Syll. Fung. 11 (1895) 30.

LUZON, Mountain Province, Baguio, *Philip. Nat. Herb. 2924 Mendoza:* Tayabas Province, Lapit, *Philip. Nat. Herb. 2945 Alcasid and Edaño.*

MARASMIUS OREADES Bolton.

Marasmius oreades BOLTON in Fries, Epicr. Syst. Myc. (1836) 375; Hym. Eur. (1878) 467; SACCARDO, Syll. Fung. 5 (1887) 510; BRESADOLA, Icon. Myc. 10 (1929) 490.

LUZON, Pangasinan Province, Binalonan, *Philip. Nat. Herb. 7061 Mendoza:* Tayabas Province, Mount Biga, *Philip. Nat. Herb. 7118 Edaño.*

Genus OMPHALIA Persoon

OMPHALIA GERARDIANA Peck.

Omphalia gerardiana PECK, N. Y. State Mus. Rept. 26 (1874) 54; 45 (1893) 37; FARLOW, Icones Farlowianae (1929) 4.

LUZON, Tayabas Province, Mount Kamates, *Philip. Nat. Herb. 2847 Edaño.*

OMPHALIA VENTOSA Fries.

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LUZON, Tayabas Province, Tignoan, *Philip. Nat. Herb. 7109 Edaño.*

Genus PLEUROTUS Fries

PLEUROTUS FUSCUS (Batt.) Bresadola.

Pleurotus fuscus (Batt.) BRESADOLA, Icon. Myc. 6 (1929) 286.

Agaricus eryngii DE CANDOLLE in Fries, Epicr. Syst. Myc. 1 (1836) 84; Hym. Eur. (1878) 171; SACCARDO, Syll. Fung. 5 (1887) 347.

Clitocybe cardarella FRIES, Hym. Eur. (1887) 80.

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Russula carnicolor BRESADOLA in Rea, Brit. Basid. (1922) 477; Icon. Myc. 9 (1929) 427.

Russula lilacea QUÉLET in Saccardo, Syll. Fung. 5 (1887) 465.

Russula lilacea var. *carnicolor* BRESADOLA in Saccardo, Syll. Fung. 11 (1895) 30.

LUZON, Mountain Province, Baguio, *Philip. Nat. Herb. 2924 Mendoza:* Tayabas Province, Lapit, *Philip. Nat. Herb. 2945 Alcasid and Edaño.*

Genus TUBARIA Smith

TUBARIA FURFURACEA Persoon.

Tubaria furfuracea PERSOON in Fries, Syst. Myc. 1 (1836) 262; Hym. Eur. (1878) 272; COOKE, Handbook of Brit. Fung. Fung. (1871) 136; SACCARDO, Syll. Fung. 5 (1887) 872; BRESADOLA, Icon. Myc. 17 (1930) 816.

LUZON, Tayabas Province, Lapit, *Philip. Nat. Herb. 2944 Alcasid and Edaño:* Manila, Harrison Park, *Philip. Nat. Herb. 7043 Reyes.*

ILLUSTRATIONS

[Drawings prepared by José M. Mendoza.]

TEXT FIGURES

FIG. 1. *Cercospora athyrii* Mendoza sp. nov.
2. *Cercospora balsaminae* Mendoza sp. nov.
3. *Cercospora carthami* Mendoza sp. nov.
4. *Cercospora jacobinae* Mendoza sp. nov.
5. *Cercospora malvastri* Mendoza sp. nov.
6. *Cercospora merremiae* Mendoza sp. nov.
7. *Cercospora momordicae* Mendoza sp. nov.
8. *Cercospora operculinae* Mendoza sp. nov.
9. *Cercospora pelargonii* Mendoza sp. nov.

NOTES ON THE ORCHID BUG, MERTILA MALAYENSIS DISTANT, ON WHITE MARIPOSA (PHALAENOPSIS AMABILIS BLUME)

By Santiago R. Capco

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TWO PLATES

Orchid cultivation is now a popular hobby and occupation in the Philippines. Success in the cultivation of orchids depends on various factors. It is known, for example, that certain insects cause considerable damage to orchids. A knowledge, therefore, of some of these destructive insects, and effective methods for their control and eradication, is therefore desirable.

In February, 1940, Dr. E. Quisumbing, of the Natural History Museum Division, received a shipment of orchids (Palawan white mariposa, *Phalaenopsis amabilis* Blume) for Major V. Barros, an orchid fancier. These orchids were placed in the orchid house. A few days later the leaves were turning yellow, drying, and falling off. Careful observations revealed that the plants were badly infested with a capsid bug, *Mertila malayensis* Distant. All stages of the insect, such as eggs, nymphs, and adults, were found among the leaves of the plants in the orchid house.

On account of the severity of infestation, causing great damage to the orchids, a study was undertaken on the life history and habits of this pest, with the ultimate aim of formulating measures for its control.

The study was conducted in the laboratory of the Natural History Museum Division, Department of Agriculture and Commerce, Bureau of Science Building, Manila, from February to May, 1940. Some observations on the habits of the insect were also made in the orchid house of the same institution.

REVIEW OF LITERATURE

Mertila malayensis Distant was originally described by Distant(2) in 1904 from specimens collected by H. N. Ridley in

Singapore, Federated Malay States. In the same year Distant(3) included the description of the genus and the species in his Fauna of British India, Rhynchota. He gave the distribution as Burma, Bhamo, and Singapore.

Roepke(7) described the biology of this insect as a capsid flower bug harmful to orchids (*Phalaenopsis amabilis* Blume and *Vanda* spp.) in Java.

Dammerman(1) gave a short account of the pest, describing it as a pest of orchids, especially *Phalaenopsis amabilis,* and stating that the species has been found from India to Java and introduced into Germany. The eggs are deposited in the plant tissue; nymphs are gregarious, and both nymphs and adults cause damage by sucking the leaves, flower stalks, and roots of the plants, causing the leaves to turn yellow and to fall off. Dammermann suggests collection of the bugs or spraying with soap solution as a means of control.

Leefmans(5) includes this species as a pest of orchids in the Netherland Indies, recommending a spray of derris and soap for effective control.

Franssen and Tiggelovend(4) prepared a short account of the biology of this orchid bug among other orchid pests in Java, giving description, behavior, development, host plants (*Phalaenopsis amabilis, Renanthera matutina,* and species of *Bulbophyllum* and *Vanda*), the nature of the damage done, as well as the means of controlling this insect.

DISTRIBUTION

This insect has been recorded in Singapore (1904), Burma and Bhamo (1904), Java (1918), Netherland Indies (1931), and India (1929), and was reported introduced into Germany.

This pest is reported here for the first time from the Philippines. Damage was especially noted in Manila on white mariposa, *Phalaenopsis amabilis* Blume, collected from Palawan.

MANNER OF INJURY TO ORCHIDS

Injury to the orchid plants is due to the feeding and oviposition punctures made by the insect (Plate 1). The adults and nymphs suck the juice of the leaves, peduncles, and the roots. Young and old leaves of *Phalaenopsis amabilis* have been observed to be attacked by the bugs. The nymphs, on account of their gregarious habit, have been able to do great damage within a few days. Infestation is easily noticeable on both surfaces of the leaves, the feeding punctures appearing as creamy-white spots that later become yellow; excreta of the bugs are also present in the form of numerous black specks. Seriously injured leaves dry up and fall off. Affected roots and peduncles also show signs of drying.

Injury to the orchid plant is done also by the oviposition of the eggs inside the leaves (Plate 2, fig. 1). In laying, the female inserts the eggs beneath the epidermis of the leaf, thus destroying the chlorophyllous cells in that area.

Moreover, the injuries resulting from oviposition punctures and the sucking of the juice in the leaves by the nymphs and adults may serve as possible avenues for the entry of disease organisms.

BIOLOGY

Eggs, nymphs, and adults were collected from infested white mariposa (*Phalaenopsis amabilis* Blume) in the orchid house and reared in the laboratory. The eggs inside the tissues of the leaves were cultured in petri dishes 10 centimeters in diameter and 1.5 centimeters high. Moist cotton was provided inside each dish. Nymphs and adults were reared separately in battery jars 18 by 12 centimeters, provided with fresh leaf of *Phalaenopsis amabilis*. The battery jars were covered with cheese cloth. Individual rearing of the bug was done in glass vials 80 by 25 millimeters with absorbent cotton plugs. The feed was changed daily or once every two days. Observations were made also on adults pairs in glass vials.

The habits of the insect were also observed in the orchid house.

ADULTS

Description.—Elongate-oval (Plate 2, fig. 5); head rather long, depressed in front of insertion of antennæ. Antennæ with first segment shorter than head and generally tapering at base, second segment much longer than first, remaining segments pilose; pronotum about one and one-half times as long as broad, with an anterior collar which has its anterior and posterior margins carinate, subimpressed or distinctly constricted before middle, the depression having two transverse callosities with a little hallow area between them, surface of posterior two-thirds densely and finely punctate; scutellum small, subtriangular, callous, foveate near base; hemelytra much longer than abdomen, membranal cell long, triangular; legs moderately short and slender, tibiæ finely setose, apical joint of tarsi incrassate; upper surface very finely and obscurely pilose.

Orange-red; apex of first joint of antennæ, legs, apex of rostrum, membrane, extreme apices of femora, tibiæ, tarsi, and abdomen beneath indigo black; posterior half of clavus, corium (excluding basal area) and cuneus shiny blue-black; basal half of third joint of antennæ creamy-yellow.

Male, length, 4.8 to 5.6 millimeters; width, 2.1 to 2.3. Female, length, 5 to 5.6 millimeters; width, 2.2 to 2.4.

The sexes are easily distinguished by differences in the ventral caudal end of the abdomen; in the male (Plate 2, fig. 6) there are present a pair of long, coiled genital claspers, while the female (Plate 2, fig. 7) has an ovipositor held close to the abdomen when not in use.

Habits.—Observations were made on five pairs of adult bugs in the laboratory from their emergence to death. The insect was so voracious that a number of orchid plants were almost defoliated during the progress of the rearings, and the food supply was therefore a major problem.

Mating was observed to take place mostly during the early part of the day. It was accomplished by the male mounting on the female, the pair then remaining with the ends of their abdomina together for several hours. Their heads were in opposite directions. The bugs were able to feed while in copula.

The eggs were laid by means of inserting the ovipositors of the females beneath the epidermis of the leaves parallel to the veins. The females mostly laid their eggs on the lower surface of the leaves. Each egg had the smaller end reaching the lower surface of the leaf and was provided with a pasty cover which dried later. After laying the eggs the female secreted a white fluid through the anus and then spread it by means of her rostrum. This white fluid soon dried and covered all the eggs deposited. In this way it was easy to locate the spot where the insect laid the eggs

As shown in Table 1, each female makes one to four or six egg spots a day. The number of eggs laid on each egg spot was one to five or eight. Each female laid one or two to ten or twelve eggs a day. The average was five eggs a day.

The number of laying days was observed to be from 21 to 23. The total number of egg spots made during the laying period was from 49 to 73. The total number of eggs laid was from 81 to 135.

TABLE 1.—*Egg-laying data of five females of Mertila malayensis.*

Culture number.	Laying days.	Total number of egg spots.	Egg spots made daily.			Total number of eggs laid.	Number of eggs per egg spot.			Number of eggs laid daily.		
			Min.	*Max.*	*Ave.*		*Min.*	*Max.*	*Ave.*	*Min.*	*Max.*	*Ave.*
1	21	59	1	6	3	104	1	6	2	1	12	5
2	23	73	1	6	3	135	1	6	2	1	12	6
3	21	49	1	5	2	101	1	6	2	2	10	5
4	23	42	1	4	2	81	1	8	2	1	10	4
5	22	63	1	6	3	121	1	5	2	1	12	5
Average	22	57.2	1	5.4	2.6	108	1	6	2	1	11	5

TABLE 2.—*Longevity of adult Mertila mayalensis, based on five males and five females.*

Culture number.	Emerged.	Died.	Duration.
MALES	*March, 1940*	*1940*	*Days.*
1	7	March 31	24
2	8	April 13	36
3	8	April 8	31
4	10	April 6	27
5	10	April 12	33
Average			30.2
FEMALES			
1	6	April 6	31
2	8	April 15	38
3	8	April 10	33
4	10	April 16	37
5	10	April 12	33
Average			34.4

The longevity of the five males and five females is shown in Table 2. After emergence the adult males were observed to live from 24 to 36 days, and the adult females, from 31 to 38 days. According to Franssen and Tiggelovend (4) the adult bugs live for about 2 months in Java.

EGGS AND NYMPHS

The egg is ellipsoidal, slightly curved towards the smaller end (Plate 2, fig. 2). It is glistening light yellow, 1.1 millimeters long and 0.25 millimeters wide. The color turns to rose when the egg is about to hatch.

The young nymph is ovoid, 1.2 millimeters long and 0.3 millimeter wide (Plate 2, fig. 3), rose-colored, with light-colored, slender antennæ and legs.

The old nymph is also ovoid, 4 by 2 millimeters, and brick-red (Plate 2, fig. 4). The ventral side of the abdomen is lighter; the legs and antennæ are yellow; the eyes are red. The wing pads are prominent.

The nymphs are active and gregarious. When disturbed they scatter and hide on the opposite side of the leaf and among the roots of the plants.

LENGTH OF LIFE CYCLE

Data on the life cycle of the 25 orchid bugs that were successfully reared in the laboratory are given in Table 3. The incubation period of the eggs ranges from 15 to 16 days, with a mean of 15.5 ± 0.1012 days. There are five nymphal instars. The duration of the first instar ranges from 3 to 4 days, with a mean of 3.2 ± 0.0592 days; the second instar, 3 to 4 days, with a mean of 3.5 ± 0.1012 days; the third instar, 3 to 4 days, with a mean of 3.3 ± 0.0917 days; the fourth instar, 4 to 5 days, with a mean of 4.2 ± 0.0876 days; and the fifth instar, 5 to 6 days, with a mean of 5.3 ± 0.0953 days. The pupal period was observed to range from 18 to 21 days, with a mean of 19.6 ±0.1426 days.

TABLE 3.—*Life cycle of the orchid bug, Mertila malayensis Distant.*

Stage.	Number of cultures.	Duration in days.				
		Minimum.	Maximum.	Mean.	Standard error.	Standard deviation.
Incubation period	25	15	16	15.5	0.1012	0.5063
First instar	25	3	4	3.2	0.0592	0.2962
Second instar	25	3	4	3.5	0.1012	0.5063
Third instar	25	3	4	3.3	0.0917	0.4587
Fourth instar	25	4	5	4.2	0.0876	0.4378
Fifth instar	25	5	6	5.3	0.0953	0.4766
Nymphal period	25	18	21	19.6	0.1426	0.7130
Egg to adult	25	33	37	35.0	0.1780	0.8898
Emergence to egg laying	15	6	12	8.4	0.4451	1.7237
Life cycle (egg to egg)	15	41	46	43.7	0.3472	1.3157

In Java, according to Franssen and Tiggelovend(4) the duration of the egg stage is not known and the nymphal period lasts about 4 weeks.

The period from the laying of the egg to the emergence of the adult lasts from 33 to 37 days, with a mean of 35 ± 0.178 days. Among the emerging adults were 10 males and 15 females. The 15 adult females began to lay eggs from 6 to 12 days after emergence, with a mean of 8.4 ± 0.4451 days. The total life cycle of the females was observed to be from 41 to 46 days, with a mean of 43.7 ± 0.3472 days.

SUGGESTIONS ON MEANS OF CONTROL

The following suggestions are submitted as means of controlling the orchid bug, *Mertila malayensis*:

1. Collecting and destroying the eggs, nymphs, and adults when present on the orchid plants.

2. Spraying or dipping the orchid plants in insecticide solutions, such as soap, nicotine sulphate, derris, and pyrethrum compound.

Ordinary laundry soap at the rate of 4 to 6 grams per liter of water is effective as contact spray.

Tobacco decoction prepared by boiling 100 grams of tobacco waste (cut stems and leaves) in a liter of water for about 30 minutes may be used, 1 part in 4 to 6 parts of water. Nicotine sulphate, a concentrated tobacco extract, may be used as spray, 1 part mixed with 700 to 800 parts of water.

Derris powder which contains about 3 to 4 per cent rotenone is also effective at 2 to 6 grams per liter of water. Pyrethrum compound may be used like derris powder, at 2 to 5 grams per liter of water.

Any of the above-mentioned insecticides will be more effective if mixed with soap solution in the proportions given.

3. Orchid plants should be kept in well-screened orchid houses in order to protect them from the attack of this destructive pest.

4. Newly collected or bought orchid plants should be segregated and examined for the presence of this pest, which is often carried with the host plants. It is important that these plants be immersed once a week in any of the above solutions until all the pests harbored by them are killed.

SUMMARY AND CONCLUSIONS

1. *Mertila malayensis* Distant is a capsid bug pest of orchids, especially *Phalaenopsis amabilis*. It attacks leaves, peduncles, and roots of orchid plants, causing great damage.

2. The species has been reported from Singapore, Burma, Bhamo, Java, Netherland Indies, and India, and has been introduced into Germany. This pest is reported for the first time in the Philippines.

3. The bugs injure the orchid plants by means of feeding and oviposition punctures. The badly infested leaves dry up and fall off.

4. The adult bugs are described. Mating takes place during the early part of the day and lasts for several hours.

5. Observations on egg-laying are given. Eggs are laid in the tissues of the leaves, parallel to the veins, either singly or in groups of from 5 to 8 eggs in an egg spot. A female makes from 1 to 6 egg spots a day and makes a total of 49 to 73 egg spots during her laying period. Each female lays from 1 to 12 eggs a day. The total number of eggs laid by each female is 81 to 135. The males live 24 to 36 days, and the females 31 to 38 days.

6. The egg and the young and old nymphs are described. The nymphs are very active and gregarious.

7. The incubation period of eggs lasts from 15 to 16 days, with a mean of 15.5 ± 0.1012 days. There are five nymphal instars; the nymphal period lasts from 18 to 21 days, with a mean of 19.6 ± 0.1426 days. The length of the life cycle as observed in the laboratory is 41 to 46 days, with a mean of 43.7 ± 0.3472 days.

8. Suggestions on means of control are included, as collecting and destroying the pest; spraying or dipping the infested orchid plants in soap, nicotine, sulphate, or derris solution, or pyrethrum compound. Screening orchid houses gives good protection to orchids from the attack of the pest, and newly acquired plants should be segregated and immersed in insecticide solution in order to kill all pests harboring on them.

ACKNOWLEDGMENT

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ILLUSTRATIONS

[The drawings were prepared by illustrators of the National History Museum Division.]

PLATE 1

Orchid plants (*Phalaenopsis amabilis* Blume) showing damage done by orchid bugs. Fig. 1, plants in the early stage of infestation; *2*, badly damaged plants. × ¼.

PLATE 2

FIG. 1. A lower portion of an orchid (*Phalaenopsis amabilis* Blume) leaf showing deposited eggs, × 2; *2*, egg, × 35; *3*, young nymph, dorsal view, × 20; *4*, old nymph, dorsal view, × 10; *5*, adult bug, dorsal view, × 8; *6*, caudal end of adult male abdomen, ventral view, × 10; *7*, caudal end of adult female abdomen, ventral view, × 10.

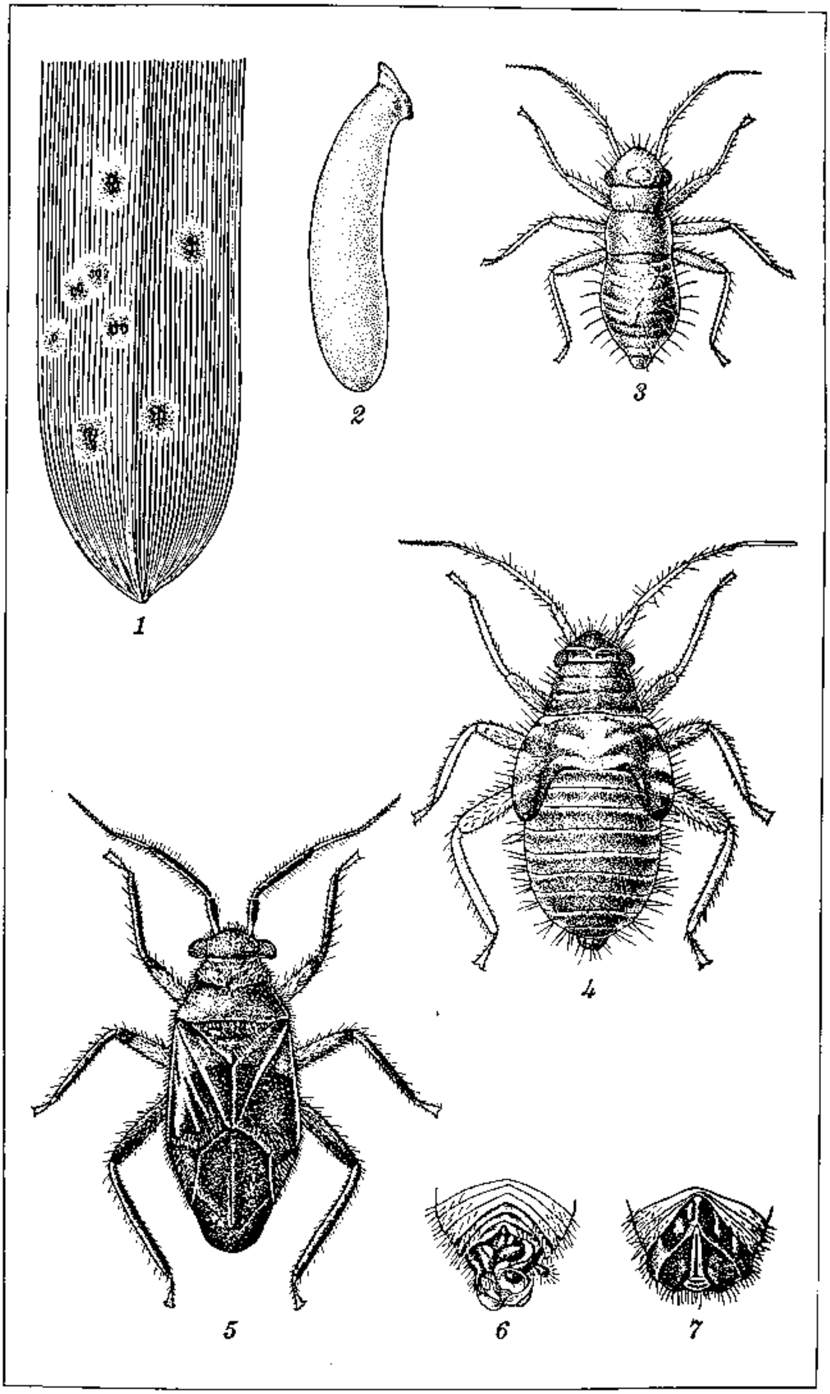

PLATE 1.

1

2

PLATE 2.

SUPPLEMENTARY NOTES ON THE ILOKO VERB

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MOODS AND TENSES

I. 1. The present and past tenses have been studied with each prefix, infix, and suffix, which have ordinarily two forms, one for the present and one for the past.

2. The past is often indicated, besides, by the use of the conjunction *idí*, 'when,' or of the adverbs of time referring to the past. Examples:

idi immáyak	when I came.
idí panagáladda	when they made the fence.
idí pannakabáutna	when he was whipped.
idí ipapatáyna	when he died.
idí kalmán ti yaáyna	he came yesterday.
simman͠gpét idí malém	he arrived yesterday afternoon.
itáy ti panagságadmi	we swept it just now.
itáy bigát tí pannakasárakmi kenkuána	we found him this morning.

3. When the past tense has to be emphasized, or when it can be inferred neither from the form of the verb nor from the construction of the sentence, the Iloko put the adverb *itáy* or *idí* after the verb. Examples:

napán idí	he went formely.
nagsán͠gitak idí	I wept formerly.
nagpilpilayak idí	I was limping at the time.
siká idí	was it you?
nasin͠gpét idí	he was good.
gayyémko idí	he was my friend.
addá idí	there was some.
awán idí	he was not there.
managibit idí	he wept very much.
napalálo itáy	it was too much.
dakayó itáy	was it you?
kaaróbami itáy	they were our neighbors.
addá itáy	he was here.

II. The imperative is not distinguished from the present in affirmative sentences; in negative sentences, however, the adverb of negation *di* is often preferred to *saán.* Examples:

mapánka	go.
ínkayo	go.
agsán͠gitka	weep.
agkatáwakayo	laugh.
díka mapán	don't go.
díkayo matúrog	don't sleep.
díka aláen	don't take it.
díkay isan͠gpét	don't bring it in.
saánka a mapán	you don't go (or, don't go; or, you shall not go).

III. The future is indicated by:

1. The conjunctions: *intóno, no* (ordinary forms), *tóno, attóno,* (rarely used); they are followed by a verb in the present. Examples:

intóno umáy	when he shall come.
intón awán ti táo	when there is nobody.
intóno agpabáut agtaráykami	when he has us whipped we shall run away.
baútek no umáy	I shall whip him when he comes.
aláek no suman͠gpét	I shall take it when he arrives.
tóno mayát gatán͠gek	I shall buy it when he is willing.
attóno pumánaw	when he goes away.
antón addá	when he is there.

2. The interrogatives: *intonanó* (ordinary form), *no anó, tonanó, attonanó, antonanó* (rarely used). Examples:

intonanó ti yaáyna	when does he come?
intonanó ti panan͠gyégyo	when do you bring it?
intonanó ti panagsán͠gityo	when do you weep?
intonanó ti pannatúrogmo	when do you sleep?
no anó ti panagálayo	when do you take it?
tonanó ti panagpandilín͠gna	when will she wear skirts?
attonanó ti kayátna a maarámid	when does he want it done?
antonanó ti panagsúratmo	when do you write?

3. The adverbs of time referring to the future. Examples:

umáyak no bigát	I shall come tomorrow.
intóno malém ti panagsaritana	he will talk this afternoon.
intóno rabíi ti yaáymo	come this evening.
mapánda rabíi no bigát	they will go tomorrow evening.
ínka bigát no bigát	go tomorrow morning.

4. The addition of the adverb *to* to one of the words of the clause intimating the future, ordinarily and more correctly to

the first word. When the adverb *to* is joined to a word ending in a vowel, the ligature *n* connects the two. Examples:

mapánakto	I shall go.
aláemto	you will take it.
mayátakto no mayát ti kabsátko	I shall be willing when my brother is willing.
bagásto ti gatán͠genda	they will buy rice.
saganáenminto	we shall prepare it.
sagádanyonto	you will sweep it.
sikánto ti ayabák	I shall call you.
ínkanto man͠gála ti págay idiáy Bantáy	you will go to get rice at Bantay.
napigsánto ti kabáyom	your horse will be strong.
tínto umáwat	the one who will receive.
aniánto ti dawáték	what shall I ask?
itédkonto kenká úrayto pay ti gudduá ti pagariák	I shall give it to you even though it were one half of my kingdom.
didanto maramanán ni rígaten	they will not taste hardship henceforth.

NOTE 1. The Iloko know, however, that the future is always uncertain, and therefore, when they want to express an event that will certainly take place, excluding all possibility of doubt, they use the present form without the adverb *to*. For example, *umáyto*, he will come, still including the possibility of his not coming; *umáy*, he shall come, without any doubt. In this case, the context must show what tense is really intended, the present or the future; the adverb *en*, for example, would make the verb conclusively present: *umáyen*, he is coming, he comes already.

IV. To indicate that something happens after something else, the action which is last in time is introduced by the conjunction *sa*. The peculiarities connected with the use of the possessives when *sa* is followed by a substantive or a substantival verb, have been alluded to before.[1]

1. The simple conjunction *sa:*

a. When both clauses are in the past. Examples:

immáy ti lakáy sa pimmánaw ti bakét	the old man came and then the old woman went away.
nan͠gála ití bagás sána inláko	he took rice and then sold it.
nagtaráy ti áso sa natáy	the dog ran and died.
nagsán͠git ti ubín͠g sáda bináut	the child wept and they whipped him.
pimmídut ti kaarróbami sákam indarúm	our neighbor stole and we sued him.
intaráyna sána inasáwa	he eloped with her and then married her.
inbátina sa nagbabáwi	he left it and then repented.

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[1] The Pronoun. II. Possessives, 2. Pecularities, 1. Anthropos 28 (1933) 691.

b. When both clauses are in the present. Examples:

umáyka sáak mapán	come and I shall go.
man͠gálaka ití págay sáda mayát	take rice and they will be willing.
suman͠gpétda sákam man͠gála	let them arrive before we take some.
bumassit sa umadú	it decreases and then increases.
agásan ti gayyémko sa umimbág ti masakít	my friend treats him and the sick person gets well.
gatán͠genda sáda iláko	they buy it and then sell it.
agkatáwakami sákay ipagél	we laugh and you forbid it.
mayátka sádaka gayyém	be willing and you shall be our friend.

c. When the first clause is in the past, the second in the present. Examples:

nagsán͠git idí kalmán sána dawáten manén	he wept yesterday and now asks for it again.
inlákona sána paisublí	he sold it and now wants it back.
nagtaráyka sáka umáy ditóy	you ran and now come here.
inálana sa agun͠gét	he took it and now is angry.
mayát pay idi sa madi itá	he was still willing at the time and now refuses.

2. The conjunction *sa* combined with the adverb *to*, when the second clause is in the future. Examples:

birókem ti napúkawmo sákanto man͠gála iti kaném	look for what you lost and then take your food.
kitáem no addá sádanto agrubbuát	look if he is there and then they shall start.
agsán͠gitkayo sádakayonto baúten	weep and they will whip you.
tarakném daytóy sákamto ibílan͠g n͠ga anákmi	bring this one up and we shall adopt him.
sumápulka sákanto sumakdó	look for some and then draw water.
umimbág pay sánto mabalín	let him first get well and then it will be allowed.
saán a mapán sánto magongonaán	if he does not go he will be rewarded.
aláenna sánanto lutoén	he takes it and then he will cook it.
inálana idí kalmán sánanto isublí no bigát	he took it yesterday and he will return it tomorrow.
nan͠gán itáy sánto dumáwat manén	he ate just now and then he will ask for it again.
nagkatáwa itáy bigát sánanto ibabáwi no malém	he laughed this morning and he will repent this afternoon.
ginátan͠gmi ti káyo sákamto agpatakdér iti baláy	we bought timber and then we shall build a house.

V. The conditional is indicated by the conjunction *no* and the adverb *komá;* the verb is either in the present or in the past.

1. Conditional clause: either *no komá no* introduces it, or *no* introduces it and *komá* follows the first word or words.

2. Principal clause: *komá* follows the first word or words; sometimes, however, it is dropped. Examples:

no komá no nasiñgpét ti ubíñg gongonaánmi komá	if the child were virtuous, we should reward him.
no komá no addá idiáy payégmi komá ditóy	if it were there, we should bring it here.
no komá no saán a rabíi inkam komá agay-áyam	if it were not evening, we should go to play.
no komá no addá ásomi índa komá mañganúp	If we had a dog, they would go hunting.
no komá no sumañgpét ti ubíñg awán komá ti pambáryo	if the child would arrive, you would have no excuse.
no komá no basáentayo ti súrat ammótay komá ti ipadámagna	if we read the letter, we should know what he announces.
no komá no ginátañgda ti suká naímas komá ti sidá	if they had bought vinegar, the food would be palatable.
no komá no immáy ti gayyémko idí kalmán siák ti mapán no bigát	if my friend had come yesterday, I should go tomorrow.
no komá no saánda a nagsáñgit saántay komá a sinaplít	if they had not wept, we should not have whipped them.
no komá no nalpás ti baláyna saánna komá a ginátañg daydí maysa	if his house had been finished, he would not have bought that other one.
no komá no immáy ti lakáy napánkami komá	if the old man had come, we should have gone.
no mapán komá ti kabsátmi agnanaédda komá ditóy	if our brother would go, they would stop here.
no nalukmég komá ti anákko díak komá madanágan	if my child were fat, I should not be worried.
no saánka komá a nasadút aramídem komá ti baláymo	if you were not lazy, you would make yourself a house.
no adú komá ti bagás baknáñgda komá	if there were much rice, they would be rich.
no awán komá ti pagpeggadán ínkam komá idiáy	if there were no danger, we should go there.
no naimbágkayo komá ñga ubbíñg adú komá ti kúkuayo	if you were good children, you would have much property.
no ilákona komá ti baláyna gatáñgenmi komá	if he sold his house, we should buy it.
no inasáwana komá ti balásañgko díak komá rebbéñg ti agpalpalamá	if he had married my daughter, I should not be obliged to beg.
no nañgála komá ti kaaróbayo kadagití alikámenna saánna komá a rebbéñg ti bumúlod	if your neighbor had taken his furniture, he would not be obliged to borrow things.
no binantáyanna komá ti págaymi saán komá a kinnán ti bábuy	if he had watched our rice, the pigs would not have eaten it.

VI. The subjunctive is indicated by the adverb *komá* placed after the first word or words of the sentence. Examples:

mañgála komá	he should take some.
birókem komá	you should look for it.
isú komá ti aramídenna	that is what he should do.
awán komá ti ásoda	they should have no dog.
siká komá ti mapán	you should go.
mabalín komá	it should be possible.
ibáonmo komá ití baláy	you should send it to the house.
simmañgpét komá ti anákko	my son should have come home.
ginátañgmi komá ti baláyda	we should have bought their house.
ti komá púsa ti inálam	you should have taken the cat.
ni komá Pédro ti nañgbaón kaniák	Peter should have sent me.

VII. The optative is indicated by the conjunctions: *sápay (komá) ta, sápay (komá) . . . ta, sápay (komá) no, sápay (komá) . . . no, napiá (komá) no, námak (kad) komá no, naimbág (komá) no,* and other ordinary forms, and the rarely used forms *amañgán no . . . komá, ñgáman ta . . . komá.* The verb is either in the present or in the past. Examples:

sápay komá ta awán idiáy	I wish he were not there.
sápay komá ta ilákona ti masápulmi	I wish he sold what we need.
sápay komá ta makabírok ití ásomi	I wish he might find our dog.
sápay komá ta ginátañgna ti baláy	I wish he had bought the house.
sápay ta yégna a dágus	I wish he brought it at once.
sápay komá ití Diós ta mapánda	would God they went.
sápay ken apó Diós ta sumañgpét	would God he arrived.
sápay komá no makaálakami	I wish we could take some.
sápay no makapagnáak	I would I could walk.
sápay komá ití Diós no umdús ti kanénmi	would God we had enough food.
sápay ití Diós no maipabúlodda	would God they allowed us to borrow it.
napiá komá no awán ti nagsakít	all right if there were no sick people.
napiá pay no agyánka komá ditóy	it would be better if you stayed here.
námak kad komá no umáyda itá	I would they came now.
námak komá no makaruárka	I would you passed your examination.
naimbág komá no awán ti madí	it were all right if nobody refused.
naimbág no mayát	all right if he is willing.
di pay naimbág komá no awán ti matáy kadatayó	would it not be lovely if none of us died?
nasayáat komá no madi	I wish he refused.
nasayáat no addá	all right if he is there.
amañgán no matáyak komá gapó kenká	I wish I might die for you.
ñgáman ta addá komá agláko	I would some people sold it.
ñgáman ta nagsúratak komá idí	I would I had written before.

VIII. The infinitive and the present participle, as we understand them in English, are rendered into Iloko by a verb connected with a substantive, a predicate or another verb, either immediately or by a ligature.

1. Infinitive:

a. A verb connected with an auxiliary (no ligature). *See* Auxiliaries.[2] Examples:

napán nañgála	he went to take some.
napánna ginátañg	he went to buy it.
ínna aláen	he goes to take it.
immáy simmakdó	she came to draw water.

b. An adjectival verb connected with a predicate by the ligature *ti*. *See* The Ligature *ti* (2).[3] Examples:

naimbág ti aginaná	it is good to rest.
nakaay-ayát ti agay-áyam	it is lovable to play.
dákes ti agtákaw	it is bad to steal.

c. An adjectival verb connected with a substantival verb by the ligature *ti*. *See* The Ligature *ti* (3).[4] Examples:

kayátko ti mapán	I want to go.
ammóna ti agbása	he knows how to read.
kayátmi ti agádal	we want to learn.
mabalínko ti agikkís	I can shout.

d. A substantival verb connected with a substantive by the ligature *a* or *ñga*. *See* The Ligature *a* or *ñga* (II, B, 8).[5] Examples:

annóñg a saán a tuñgpálen	a duty not to be complied with.
rebbéñg a lualoén	one should recite the prayer (literally: a duty to recite the prayer).
táo ñga ayatén	a man to be loved.

e. A substantival verb connected with a predicate by the ligature *a* or *ñga*. *See* The Ligature *a* or *ñga* (II, B, 8).[6] Examples:

dákes ñga inumén	it is bad to drink it.
nakaskasdáaw a kitkitáen	it is wonderful to behold.
dákes a di patién ti saóna	it is bad not to believe his words.
naalás ñga isúrat	it is bad taste to write it.
narígat a baonén	it is hard to send him.
dákes ñga aramíden	it is bad to do it.
maikarí ñga annugóten ti naganák kadatáo	our parents are worthy to be obeyed.

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[2] Page 205. [3] Unpublished. [4] Ibid. [5] Ibid. [6] Ibid.

f. A substantival verb connected with another substantival verb by the ligature *a* or *n͠ga*. *See* The Ligature *a* or *n͠ga* (II, B, 11).[7] Examples:

ammóm n͠ga inornón͠g	you knew how to gather them.
ammóm n͠ga inilalá	you knew how to take good care of it.
kayátko n͠ga aláen	I want to take it.
itédna n͠ga ipainúm	he gives it to drink.
ammóna a sapúlen	he knows how to look for it.
kayátda a gatán͠gen	they want to buy it.

2. Present participle:

a. A verb connected with a predicate by the ligature *a* or *n͠ga*. *See* The Ligature *a* or *n͠ga* (II, B, 9).[8] Examples:

nadarásyo n͠ga inúla	you were quick getting it.
nasadút a mamúnag	he is lazy in carrying.

b. An adjectival verb connected with another adjectival verb by the ligature *a* or *n͠ga*. *See* The Ligature *a* or *n͠ga* (II, B, 13).[9] Examples:

agpukpukkáwkayo a matmatúrog	you shout in your sleep (literally: sleeping).
agsursúrat a man͠gman͠gán	he writes eating.
agbasbásaka a magmagná	you read walking.
agináyadda n͠ga agtaráy	they run slowly (literally: they go slow running).

c. An adjectival verb connected with *addá* by the ligature *a* or *n͠ga*. *See* The Ligature *a* or *n͠ga* (II, B, 14).[10] Examples:

addá n͠ga umáy	there he is coming.
addáda a mayát	there they are willing.

d. A substantival verb connected with an adjectival verb by the ligature *a* or *n͠ga*. *See* The Ligature *a* or *n͠ga* (II, B, 12).[11] Examples:

di sumun͠gbát n͠ga ayabán	he does not answer being called.
di tumaliáw a pakisaoán	he does not look back being spoken to.

NOTE 2. It goes without saying that the above division is more or less arbitrary, as the English forms and the Iloko forms are of an entirely different nature. That is the reason why we always refer to the corresponding treatment under the ligature.

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[7] Ibid.
[8] Ibid.
[9] Ibid.
[10] Ibid.
[11] Ibid.

IX. The English past participle is rendered into Iloko:

1. By an adjectival verb in *na*. *See* The Prefix *Ma*.[12] Examples:

naarámid	it is done.
naipatakdér ti baláy	the house is built.
naipaw-ít ti súrat	the letter is sent.
naasinán ti kárne	the meat is salted.

2. By a substantival verb in the past. Examples:

tinadtád	hashed.
linága daytá	that is woven.
tinúno ti kayátmi	we want roasted (meat, and the like).
inan͠gér komá	it should be boiled (meat).
inpaksét	burnt (rice, and the like).
minuláan	planted.
rinan͠ggásan	injured.
agarámidka ití linúgaw	make rice porridge.
inkapilítan ti panagkonáda	they say so under compulsion (literally: they are obliged).
ginagára ti pannakaitibkúlna	he stumbles on purpose (literally: intentionally).
aláem ti inapúy	take rice (literally: placed over the fire).
binubódan ti inuménda	they drink rice wine (literally: fermented).
inkíwar ti intédda	they gave us pudding (literally: stirred).

AUXILIARIES

I. The most used auxiliaries are:

1. *In* and *mapán:* to go.

2. *Umáy:* to come.

II. The auxiliaries always precede the principal verb immediately without any connecting ligature. Examples:

in agbírok	he goes to look for some.
mapán man͠gála	he goes to take some.
umáy agtákaw	he comes to steal.

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[12] Philip. Journ. Sci. 71 (1940) 22.

III. All pronouns, adverbs, and so on, that have to be joined to the verb, are always joined to the auxiliary and never to the principal verb. Examples:

ínnak aláen	I go to take it.
ínkam biróken	we go to look for it.
ínnak agláko	I go to sell.
ínkam aglúto	we go to cook.
inkanto ipúlan͠g	you will go and return it.
ínkaminsa matúrog	I think we better go to sleep.
mapántayo man͠gáyo	let us go to gather wood.
mapánda gumátan͠g	they go to buy.
mapántayo baúten	let us go and whip him.
mapánda sagádan	they go to sweep it.
mapánto man͠gán	he will go to eat.
umáyda suróten	they come to follow him.
umáykayo makiay-áyam	come and play with us.
umáyda makisaríta	they come to talk with us.
umáykayo sapliten	come and whip him.
umáysa uminúm	he probably comes to drink.
ti umáyna itatáo	his coming to become man.
kaanó ti immáyna panan͠gtéd ití daytóy	when did he bring this?

IV. When the principal verb is in the past tense the auxiliary has to be put in the same tense, provided that it be susceptible of a past form. The same rule applies to any verb connected with another verb in the past. Examples:

ínnak inála	I went to take it.
inkam binirok	we went to look for it.
napántayo nan͠gáyo	we went to gather wood.
napánda gimmátan͠g	they went to buy.
napántayo bináut	we went to whip him.
napánda sinagádan	they went to sweep it.
immáyda sinúrot	they came to follow him.
immáykayo nakiay-áyam	you came to play with us.
immáyda nakisaríta	they came to talk with us.
immáykayo sinaplít	you came to whip him.
nagináyad a nagtaráy	he ran slowly.
nagbasbása a nagnagná	he read walking.
nagsursúrat a nan͠gnan͠gán	he wrote eating.
di simmun͠gbát n͠ga inayabán	he did not answer when called.
kinayátmi ti nagádal	we wanted to study.
intédna n͠ga inpainúm	he gave it to drink.
nabalínko komá n͠ga inláko	I could have sold it.
rinugiánda a kinoná	they began to say.

REDUPLICATION OF VERBAL STEMS

I. Besides the several reduplications alluded to in the above treatment of the verb, the Iloko use extensively two kinds of reduplication of verbal stems:

1. The reduplication of the first open syllable.
2. The reduplication of the first open syllable with the next consonant if there is any.

A third one, the reduplication of two syllables, is not so common.[13]

II. 1. The first of these reduplications indicates a certain easiness, cleverness, naturalness, and so on, in the performing of the action, and so it very often indicates that something is done by many. For example: *agtugáw:* he sits; *agtutugáw:* he sits in peace, easily, restfully; *tumugáw:* he sits down; *tumutugáw:* he sits down for the smallest reason, he cannot stand for any length of time; *kumagát:* he bites (although not actually); *kumakagát:* he is a fierce one always ready to bite; *agápada:* they quarrel; *agaápada:* they (more than two) quarrel. Examples:

agiináda	they are mother and daughters.
aguulitégda	they are uncle and nephews.
nagtutúlagda a duá	both made a contract.
agtatakdérkayo	stand up.
agguguranguradanto	they will hate one another.
no panagaápit	at the time of the harvest.
agsasallópan͠gda	they face one another.
umaárem daytá baró	that young man is very much in love.
ti pagdudupudúpan	the meeting place.
lumulúto ti asáwak	my husband is a cook.
umaágas ni Pédro	Peter is a physician.
agaaráyatda	they lend a helping hand.
agsasagunsagúday dagitá	those try to outdo one another in good qualities.
nagdidigusda ámin	they all bathed.
ti panagaáyko ditóy	my coming here.
isú ti nagsasayaátanda	that is what makes them good.
ti pagoornón͠gan ti rugít	the place where dirt gathers.
dumadáit ni Ana	Ann is a seamstress.
sumusúrat daytá balásan͠g	that girl is a writer.
umaápalkayo	you are jealous.
ti pagsasan͠goán	where one faces others.

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[13] Notes on Iloko (Chapter I. VII. Reduplications, I). Anthropos 23 (1928) 1040.

NOTE 3. When the stem is a name of an animal, and the like, this reduplication and the prefix *ag* or *man͠g* very often mean: to steal the animal, and so on, in question. Examples:

agkakaldín͠g dagitá	those steal goats.
man͠gkakaldín͠gda	they steal goats.
man͠gnunuán͠g ti kailiám	your fellow citizen steals carabaos.
mamabábuy dagitóy a lakáy	these old men steal pigs.
agpapáguy ti kaaróbami	our neighbor steals rice.
nagiitlóg daytá púsa	that cat stole eggs.
agbabayábas dagití ubbín͠g	the boys steal guavas.

2. The second of these reduplications corresponds to our own progressive form. For example: *agtugáw:* he sits; *agtugtugáw:* he is sitting; *tumugáw:* he sits down; *tumugtugáw:* he is sitting down. Examples:

aytartaráy ni León	Leo is running.
nagbasbása idí malém	he was reading yesterday afternoon.
tumartaráy pay láen͠g	he is still running.
immín-inúm ti áso	the dog was drinking.
makaturtúrog daytá ubín͠g	that child is getting sleepy.
nakasarsárakda iti ugsá	they were meeting a deer.
makirin͠grin͠ggór ken kabsátko	he is quarreling with my brother.
nakidawdáwat kaniák ití árak	he was asking me for wine.
man͠gal-ála iti bagásmi	he is taking our rice.
nan͠gbakbakláy ití nadagsén	he was carrying a heavy load.
puspusáen ti tinápay	the bread is being eaten by the cat.
inas-áso ti kárne	the meat was being eaten by the dog.
makitkita ti baláy	the house can be seen.
nabanbantáyan ti págay	the rice was being watched.
sursurótennakami	he is following us.
binirbírokmi idá	we were looking for them.
banbantáyanna ti bakét	he is watching the old woman.
sinagsagádanda ti silidko	they were sweeping my room.
ipulpúlan͠gda ti pagsiláwan	they are returning the lamp.
inbabbabáda ti págay	they were lowering the rice.
ibaybayoánna idá	he is pounding rice for them.
inar-aramídanda ni kabsátko ti baláy	they were making a house for my brother.
masapsápulko	I am needing it.
nasagságidko	I was touching him.

3. The third of these reduplications indicates repetition of the same action. For example: *agtaliáw:* he looks around; *agtaliataliáw:* he looks around all the time. Examples:

agsublisublí ti ubiñg	the child is coming and going.
ti panagbaliwbáliw ti nákem	fickleness.
nagsardesardéñgkami	we stopped repeatedly.
agwakatwákat ti pandiliñgna	her shirt moves back and forth.
sumurotsúrot ti kaldiñg	the goat follows all the time.
umañges-áñges ta nagtaráy	he is panting for breadth because he ran.
masinasínada	they all separate.
naiwaraswáras ti lúpot	the clothes are scattered around.
kamatkamátenda idá	they persecute them.
pisañgpisáñgenna	he tears it up.
ginuyodgúyodda	they dragged him along.
inyunay-únayna	he recommended it insistingly.

III. When no consonant follows the first vowel of the stem:

1. The reduplication of the first open syllable retains its original meaning of easiness, and so on.

2. The progressive form is indicated by the reduplication of the initial open syllable and—

a. The shifting of the accent from the last of the two consecutive vowels of the stem, to the reduplicated syllable;

b. The reduplication of the initial consonant of the stem, if the first of the two consecutive vowels of the stem bears the accent, or if a suffix has drawn the accent after it.[14]

For example: *a. agsaó:* he talks; *agsasaó:* he talks much, noisily; *agsásao:* he is talking; *sumaó:* he speaks; *sumasaó:* he speaks well, fluently; *sumásao:* he is speaking. *b. agdáit:* she sews; *agdadáit:* she sews nicely; *agdaddáit:* she is sewing; *dumáit:* she can sew, she knows how; *dumadáit:* she sews well, she is a good seamstress, although she does not always sew; *dumaddáit:* she is sewing for a while; *saoénna:* he says; *sasaoénna:* he always says; *sassaoénna:* he is saying; *daítenna:* she sews it; *dadaítenna:* she sews it nicely, with ease; *dadduítenna:* she is sewing it.

IV. 1. When a syllable of the stem has been eliminated by syncope, through the addition of a prefix or infix, this prefix, for example, is considered, at least partially if it has more than one syllable, as a part of the stem, when reduplication occurs.[15] Examples:

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[14] Notes on Iloko Chapter I, IV. Accent, 2. Retrogression, III & IV; VII. Reduplications, 2.

lumlumtég ti luppóna	his thigh is swollen.
man͠gman͠gán ti ubín͠g	the child is eating.
manmanbí ni Ana	Ann is spinning.
mabmabló ti sákak	my foot is sprained.
kalkalpás ti lúto	the cooking is just finished.
ipadpadláwna ti kinakúnen͠gna	he shows his stupidity.
nakaskasdáaw ti makita	the sight is wonderful.
nakalkaldáan͠g a buybuyáen	it is a pitiful sight.
makan͠gkan͠gn͠gég	he can hear.

2. When the prefix is a complex one, very often the initial prefix alone is considered as such, and the rest is considered as a part of the stem, when reduplication occurs.[16] Examples:

agiinnokómda	they judge one another.
agtitinnúlon͠g dagití kaaróbami	our neighbors help one another.
agiinnápal dagití balásan͠g	the girls envy one another.
aglilinnípatda	they forget one another.
agpipinnaútan͠g dagití gayyémmi	our friends lend money to one another.
nagpipinnanúnotda iti biánggda	they thought among themselves.
agkakasinsínda	they are first cousins.
agkakataráyda	they run all together.
díkayo agkakapagná	do not walk all together.
agparparikná	he is making insinuations.
agpaspasúrotda n͠ga agluálo	they are leading the prayers.
agkarkaraipugsát ti talí	the rope is breaking all the time.
pagtagtagiammoán daytá	that is doubtful.
agin-innonákam n͠ga agkabláaw	we vie to be the first to greet him.
mamagpagságad ti bakét	the old woman is ordering sweeping.
naikaskasígud ti ayátna	he has always loved.
maipappapílit	it has to be.

3. Sometimes either the whole complex prefix, or a simple prefix, at least partially if it has more than one syllable, may

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[15] Notes on Iloko. Chapters I, VI. Syncopations, etc. I. Note. Anthropos 23 (1928) 1035.

[16] Notes on Iloko. Chapters I, VII. Reduplications, I. Note 1. Anthropos 23 (1928) 1040.

be considered a part of the stem, when reduplication occurs.[17] Examples:

um-umáy ti áso	the dog is coming.
rimrimmuár ti púsa	the cat was coming out.
mañg̃mañg̃tédkayo	you are giving.
ik-ikkám idá	give them.
marmaruám daytá	that one is getting used to it.
padpadaksénda ti gayyémda	they are slandering their friend.
pinalpalubósanna ti anákna	he was letting his son go.
pappapudótem	warm it.
parparagsákem ti inám	make your mother happy.
ipappapánko a kastá	I am supposing so.
makimkimisakami	we are always going to mass.
isú ti nakabkabasólanna	that is where he made a mistake.
natnatúrog dagiti ubbíñg̃	the children were sleeping.
nañg̃nañg̃róna a dákes	it is especially bad.
sañg̃sañg̃kagiddánda ñg̃a araméden	they do it all together
mamasírib dagitá lakáy	those old men are wise.

Note 4. The prefix *i* of complex prefixes is never considered as a part of the stem, provided it follows the simple prefix immediately. Examples:

agipabpabásol ti kaádalko	my classmate is accusing people.
agitartaráy kadagiti kúkuami	he is running away with our property.
mañg̃mañg̃yég iti bagás	he is bringing rice.
But: *agkarkaraibóoñg̃*	he always breaks things.

SYNOPSIS

To give an idea of the great number of forms a verbal stem may acquire through the addition of verbal prefixes, infixes, and suffixes, and through the different reduplications, we shall give here a list of the verbal forms of the stem *súrat*, 'writing.' This list, however, is far from complete, and we hope the student will be kind enough to supply any omissions, which might readily occur in such an enumeration.

This list is an obvious vindication of the linguist who arranges a dictionary of Iloko according to stems, and not according to complete words. It should be noted, however, that several of these forms are rarely used, and that some of them are not allowed with all verbal stems. One may have lived for years in the Iloko country without having heard each and every one of these forms; nevertheless, they are all correct and may be used occasionally, some more, others less.

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[17] Notes on Iloko. Chapters I, VII. Reduplications, I. Notes 1 & 2. Anthropos 23 (1928) 1040, 1041.

PRESENT	ENGLISH PRESENT	PAST
	1. PREFIX *AG*	
agsúrat	he writes	*nagsúrat*
agsusúrat	he writes well	*nagsusúrat*
agsursúrat	he is writing	*nagsursúrat*

NOTE 5. As it would be tedious to repeat this triple form with each separate item of this table, we shall only give the forms without reduplications; it should be noted, however, that this triple form is always allowed, except when the first open syllable is reduplicated in the original form, for example, *aginsusúrat, isusúrat,* and so on, in which case only the original form is allowed. Sometimes a part of the complex prefix is considered a part of the stem, and affects reduplications accordingly; for example: the reduplications of the form *agpasúrat* are: *agpapasúrat* and *agpaspasúrat.*

managsúrat	he writes much	
pagsúrat	something to write with	*pinagsúrat*
pagsurátan	where, why, to whom one writes	*nagsurátan*
panagsúrat	how, when one writes	
panagsurátan	writing	
pagsuráten	to order somebody to write	*pinagsúrat*
mañgpagsúrat	he orders somebody to write	*nañgpagsúrat*
mamagsúrat	do.	*namagsúrat*
manañgpagsúrat	he often orders somebody to write	
manamagsúrat	do.	
mammagsúrat	do.	
pañgpagsúrat	something with which to order somebody to write	*pinañgpagsúrat*
pamagsúrat	do.	*pinamagsúrat*
pañgpagsurátan	where, why, to whom one orders somebody to write	*nañgpagsurátan*
pamagsurátan	do.	*namagsurátan*
panañgpagsúrat	how, when one orders somebody to write.	
panamagsúrat	do.	
pammagsúrat	do.	
panañgpagsurátan	ordering somebody to write	
panamagsurátan	do.	
pammagsurátan	do.	
pañgpagsuráten	to order somebody to order another one to write	*pinamagsúrat*
pamagsuráten	do.	*pinañgpagsúrat*
mapagsúrat	he is ordered to write	*napagsúrat*

NOTE 6. The student will kindly supply each of the next forms, in which the complex prefixes are derived from the simple prefix *ag*, with all the above forms, 38 in number.

agsanúrat	he always writes	*nagsanúrat*
agisúrat	he writes something down	*nagisúrat*
agpasúrat	he orders somebody to write	*nagpasúrat*
agpanúrat	do.	*nagpanúrat*
agpaisúrat	he orders somebody to write something down	*nagpaisúrat*
agipasúrat	he gives something to be written	*nagipasúrat*
agpaipasúrat	he orders somebody to give something to be written	*nagpaipasúrat*
aginsusúrat	he pretends to write	*naginsusúrat*
agpaginsusúrat	he orders somebody to pretend to write	*nagpaginsusúrat*
agsinnúrat	to write to one another	*nagsinnúrat*
agpasinnúrat	to order to write to one another	*nagpasinnúrat*
agpinnasúrat	to order one another to write	*nagpinnasúrat*
agpinnaisúrat	to order one another to write something down	*nagpinnaisúrat*
agpinnaipasúrat	to order one another to give something to be written	*nagpinnaipasúrat*
agsuransúrat	to write to one another	*nagsuransúrat*
agpasuransúrat	to order to write to one another	*nagpasuransúrat*
agsinnuransúrat	to write to one another	*nagsinnuransúrat*
agpasinnuransúrat	to order to write to one another	*nagpasinnuransúrat*
agkaraisúrat	he always writes something down	*nagkaraisúrat*
agkaraipasúrat	he always orders somebody to write	*nagkaraipasúrat*
agkaraipaisúrat	he always orders somebody to write something down	*nagkaraipaisúrat*
agkaraipaipasúrat	he always orders somebody to give something to be written	*nagkaraipaipasúrat*
agtagisúrat	he has a letter	*nagtagisúrat*
agtagipagsúrat	he has something to write with	*nagtagipagsúrat*

agtagipagisúrat	he has something with which to write something down	*nagtagipagisúrat*
agtagipagipasúrat	he has something to give something to be written	*nagtagipagipasúrat*
agtagipagpasúrat	he has something to order somebody to write	*nagtagipagpasúrat*
agtagipagpaisúrat	he has something to order somebody to write something down	*nagtagipagpaisurat*
agtagipagpaipasúrat	he has something to order somebody to give something to be written	*nagtagipagpaipasúrat*
etc.	etc.	etc.

2. INFIX *UM*

sumúrat	he writes for a while	*simmúrat*
isusúrat	how, when one writes for a while	
pasuráten	to tell somebody to write	*pinasúrat*
man͠gpasúrat	he tells somebody to write	*nan͠gpasúrat*
mamasúrat	do.	*namasúrat*
manan͠gpasúrat	he often tells somebody to write	
manamasúrat	do.	
mammasúrat	do.	
pan͠gpasúrat	something with which to tell somebody to write	*pinan͠gpasúrat*
pamasúrat	do.	*pinamasúrat*
pan͠gpasurátan	where, why, to whom one tells somebody to write	*nan͠gpasurátan*
pamasurátan	do.	
panan͠gpasúrat	how, when one tells somebody to write	*namasurátan*
panamasúrat	do.	
pammasúrat	do.	
panan͠gpasurátan	telling somebody to write	
panamasurátan	do.	
pammasurátan	do.	

pan͠gpasuráten	to order somebody to tell another one to write	*pinan͠gpasúrat*
pamasuráten	do.	*pinamasúrat*
mapasúrat	he is told to write	*napasúrat*
etc.	etc.	etc.

3. PREFIX *MAKA*

makasúrat	he can write	*nakasúrat*
mannakasúrat	he can write much	
pakasurátan	where, why, to whom one can write	*nakasurátan*
pannakasúrat	how, when one can write	
pannakasurátan	being able to write	
pakasuráten	to make somebody able to write	*pinakasúrat*
man͠gpakasúrat	he makes somebody able to write	*nan͠gpakasúrat*
mamakasúrat	do.	*namakasúrat*
manan͠gpakasúrat	he often makes somebody able to write	
manamakasúrat	do.	
mammakasúrat	do.	
pan͠gpakasúrat	something with which to make somebody able to write	*pinan͠gpakasúrat*
pamakasúrat	do.	*pinamakasúrat*
pan͠gpakasurátan	where, why, to whom one makes somebody able to write	*nan͠gpakasurátan*
pamakasurátan	do.	*namakasurátan*
panan͠gpakasúrat	how, when one makes somebody able to write	
panamakasúrat	do.	
pammakasúrat	do.	
panan͠gpakasurátan	making somebody able to write	
panamakasurátan	do.	
pammakasurátan	do.	
pan͠gpakasuráten	to order somebody to make another able to write	*pinan͠gpakasúrat*
pamakasuráten	do.	*pinamakasúrat*
mapakasúrat	he is made able to write	*napakasúrat*

NOTE 7. The student will kindly supply each of the next forms, in which the complex prefixes are derived from the simple prefix *maka*, with all the above forms, 36 in number.

makaisúrat	he can write something down	*nakaisúrat*
makapagsúrat	it is possible for him to write	*nakapagsúrat*
makapagisúrat	it is possible for him to write something down	*nakapagisurat*
makapagsinnúrat	to be able to write to one another	*nakapagsinnúrat*
makapagsuransúrat	do.	*nakapagsuransúrat*
makapagsinnuransúrat	do.	*nakapagsinnuransúrat*
makapagpasúrat	it is possible for him to have something written	*nakapagpasúrat*
makapagpaisúrat	it is possible for him to have something written down	*nakapagpaisúrat*
makapagpaipasúrat	it is possible for him to give something to be written	*nakapagpaipasúrat*
makapagtagisúrat	it is possible for him to have a letter	*nakapagtagisúrat*
makapagtagipagsúrat	it is possible for him to have something to write with	*nakapagtagipagsúrat*
makapagtagipagisúrat	it is possible for him to have something with which to write something down	*nakopagtagipagisúrat*
makapagtagipagipasúrat	it is possible for him to have something to give something to be written	*nakapagtagipagipasúrat*
makapagtagipagpasúrat	it is possible for him to have something to order somebody to write	*nakapagtagipagpasúrat*
makapagtagipagpaisúrat	it is possible for him to have something to order somebody to write something down	*nakapagtagipagpaisúrat*
makapagtagipagpaipasúrat	it is possible for him to have something to order somebody to give something to be written	*nakapagtagipagpaipasúrat*

makapaginsusúrat	it is possible for him to pretend to write	*nakapaginsusúrat*
makapasúrat	he can have something written	*nakapasúrat*
makapanúrat	he can order somebody to write	*nakapanúrat*
makapaisúrat	he can have something written down	*nakapaisúrat*
makapaipasúrat	he can give something to be written	*nakapaipasúrat*
etc.	etc.	etc.

4. PREFIX MAKI

makisúrat	he writes with others	*nakisúrat*
mannakisúrat	he writes much with others	
pakisúrat	something with which to write with others	*pinakisúrat*
pakisurátan	where, why, to whom one writes with others	*nakisurátan*
pannakisúrat	how, when one writes with others	
pannakisurátan	writing with others	
pakisuráten	to order somebody to write with others	*pinakisúrat*
man͠gpakisúrat	he orders somebody to write with others	*nan͠gpakisúrat*
mamakisúrat	do.	*namakisúrat*
manan͠gpakisúrat	he often orders somebody to write with others	
manamakisúrat	do.	
mammakisúrat	do.	
pan͠gpakisúrat	something with which to order somebody to write with others	*pinan͠gpakisúrat*
pamakisúrat	do.	*pinamakisúrat*
pan͠gpakisurátan	where, why, to whom one orders somebody to write with others	*nan͠gpakisurátan*
pamakisurátan	do.	*namakisurátan*
panan͠gpakisúrat	how, when one orders somebody to write with others	
panamakisúrat	do.	
pammakisúrat	do.	
panan͠gpakisurátan	ordering somebody to write with others	
panamakisurátan	do.	
pammakisurátan	do.	

pañgpakisuráten	to order somebody to order another to write with others	*pinañgpakisúrat*
pamakisuráten	do.	*pinamakisúrat*
mapakisúrat	he is ordered to write with others	*napakisúrat*

NOTE 8. The student will kindly supply each of the next forms, in which the complex prefixes are derived from the simple prefix *maki*, with all the above forms, 38 in number.

makisinnúrat	to write to one another	*nakisinnúrat*
makisuransúrat	do.	*nakisuransúrat*
makisinnuransúrat	do.	*nakisinnuransúrat*
makisumúrat	he wants to write	*nakisumúrat*
makipagsúrat	he also writes with others	*nakipagsúrat*
makipagisúrat	he also writes something down with others	*nakipagisúrat*
makipaginsusúrat	he pretends with others to be writing	*nakipaginsusúrat*
makipagsinnúrat	also to write to one another	*nakipagsinnúrat*
makipagsuransúrat	also to write with others	*nakipagsuransúrat*
makipagsinnuransúrat	do.	*nakipagsinnuransúrat*
makipagpasúrat	he also with others orders something to be written	*nakipagpasúrat*
makipagpaisúrat	he also with others orders something to be written down	*nakipagpaisúrat*
makipagpaipasúrat	he also with others gives something to be written	*nakipagpaipasúrat*
makipasúrat	he also orders something to be written	*nakipasúrat*
makipanúrat	he also orders somebody to write	*nakipanúrat*
makipaisúrat	he also orders something to be written down	*nakipaisúrat*
makipaipasúrat	he also gives something to be written	*nakipaipasúrat*
etc.	etc.	etc.

5. SUFFIX *EN*

suráten	to write something	*sinúrat*
mañgsúrat	he writes something	*nañgsúrat*
manúrat	do.	*nanúrat*
manañgsúrat	he writes many things	
mananúrat	do.	
mannúrat	do.	
pañgsúrat	something to write something with	*pinañgsúrat*
panúrat	do.	*pinanúrat*
pañgsurátan	where, why, to whom one writes something	*nañgsuratan*
panurátan	do.	*nanurátan*
panañgsúrat	how, when one writes something	
pananúrat	do.	
pannúrat	do.	
panañgsurátan	writing something	
pananurátan	do.	
pannurátan	do.	
pañgsuráten	to order somebody to write something	*pinañgsúrat*
panuráten	do.	*pinanúrat*
mañgpañgsúrat	he orders somebody to write something	*nañgpañgsúrat*
mañgpanúrat	do.	*nañgpanúrat*
mamañgsúrat	do.	*namañgsúrat*
mamanúrat	do.	*namanúrat*
manañgpañgsúrat	he often orders somebody to write something	
manañgpanúrat	do.	
manamañgsúrat	do.	
manamanúrat	do.	
mamañgsúrat	do.	
mammanúrat	do.	
pañgpañgsúrat	something with which to order somebody to write something	*pinañgpañgsúrat*
pañgpanúrat	do.	*pinañgpanúrat*
pamañgsúrat	do.	*pinamañgsúrat*
pamanúrat	do.	*pinamanúrat*
pañgpañgsurátan	where, why, to whom one orders somebody to write something	*nañgpañgsurátan*
pañgpanurátan	do.	*nañgpanurátan*
pamañgsurátan	do.	*namañgsurátan*
pamanurátan	do.	*namanurátan*

panan͠gpan͠gsúrat	how, when one orders somebody to write something	
panaman͠gsúrat	do.	
panamanúrat	do.	
pamman͠gsúrat	do.	
pammanúrat	do.	
panan͠gpan͠gsurátan	ordering somebody to write something	
panan͠gpanurátan	do.	
panaman͠gsurátan	do.	
panamanurátan	do.	
pamman͠gsurátan	do.	
pammanurátan	do.	
pan͠gpan͠gsuráten	to order somebody to order another to write something	*pinan͠gpan͠gsúrat*
pan͠gpanuráten	do.	*pinan͠gpanúrat*
paman͠gsuráten	do.	*pinaman͠gsúrat*
pamanuráten	do.	*pinamanúrat*
mapan͠gsúrat	do.	*napan͠gsúrat*
mapanúrat	he is ordered to write something	*napanúrat*
masúrat	do.	*nasúrat*
pasúrat	it is written	*pinasúrat*
man͠gpasúrat	to order something to be written	*nan͠gpasúrat*
mamasúrat	he orders something to be written	*mamasúrat*
manan͠gpasúrat	he often orders something to be written	
manamasúrat	do.	
mammasúrat	do.	
pan͠gpasúrat	something with which to order something to be written	*pinan͠gpasúrat*
pamasúrat	do.	*pinamasúrat*
pan͠gpasurátan	where, why, to whom one orders something to be written	*nan͠gpasurátan*
pamasurátan	do.	*namasurátan*
panan͠gpasúrat	how, when one orders something to be written	
panamasúrat	do.	
pammasúrat	do.	
panan͠gpasurátan	ordering something to be written	
panamasurátan	do.	
pammasurátan	do.	

pañgpasuráten	to order somebody to order something to be written	*pinañgpasúrat*
pamasúraten	do.	*pinamasúrat*
mapasúrat	it is ordered to be written	*napasúrat*
etc.	etc.	etc.

6. SUFFIX *AN*

surátan	to write on something	*sinurátan*
masurátan	it is written upon	*nasurátan*
pasurátan	to order something to be written upon	*pinasurátan*
mapasurátan	it is ordered to be written upon	*napasurátan*
etc.	etc.	etc.

7. PREFIX *I*

isúrat	to write something down	*insúrat*
mañgisúrat	he writes something down	*nañgisúrat*
manañgisúrat	he writes many things down	
pañgisúrat	something to write something down	*pinañgisúrat*
pañgisurátan	where, why, to whom one writes something down	*nañgisurátan*
panañgisúrat	how, when one writes something down	
panañgisurátan	writing something down	
pañgisuráten	to order somebody to write something down	*pinañgisúrat*
mañgpañgisúrat	he orders somebody to write something down	*nañgpañgisúrat*
mamañgisúrat	do.	*namañgisúrat*
manañgpañgisúrat	he often orders somebody to write something down	
manamañgisúrat	do.	
mammañgisúrat	do.	
pañgpañgisúrat	something with which to order somebody to write something down	*pinañgpañgisúrat*
pamañgisúrat	do.	*pinamañgisúrat*

pan͠gpan͠gisurátan	where, why, to whom to order somebody to write something down	*nan͠gpan͠gisurátan*
paman͠gisurátan	do.	*naman͠gisurátan*
panan͠gpan͠gisúrat	how, when to order to write something down	
panaman͠gisúrat	do.	
pamman͠gisúrat	do.	
panan͠gpan͠gisurátan	ordering somebody to write something down	
panaman͠gisurátan	do.	
pamman͠gisurátan	do.	
pan͠gpan͠gisuráten	to order somebody to order another to write something down	*pinan͠gpan͠gisúrat*
paman͠gisuráten	do.	*pinaman͠gisúrat*
mapan͠gisúrat	he is ordered to write something down	*napan͠gisúrat*
maisúrat	it is written down	*naisúrat*
paisúrat	to order something to be written down	*pinaisúrat*
man͠gpaisúrat	he orders something to be written down	*nan͠gpaisúrat*
mamaisúrat	do.	*namaisúrat*
manan͠gpaisúrat	he orders many things to be written down	
manamaisúrat	do.	
mammaisúrat	do.	
pan͠gpaisúrat	something with which to order something to be written down	*pinan͠gpaisúrat*
pamaisúrat	do.	*pinamaisúrat*
pan͠gpaisurátan	where, why, to whom one orders something to be written down	*nan͠gpaisurátan*
pamaisurátan	do.	*namaisurátan*
panan͠gpaisúrat	how, when one orders something to be written down	
panamaisúrat	do.	
pammaisúrat	do.	
panan͠gpaisurátan	ordering something to be written down	
panamaisurátan	do.	
pammaisurátan	do.	

pañgpaisuráten	to order somebody to order something to be written down	*pinañgpaisúrat*
pamaisuráten	to order somebody to order something to be written down	*pinamaisúrat*
mapaisúrat	it is ordered to be written down	*napaisúrat*
etc.	etc.	etc.

8. COMBINATION *I . . . AN*

isurátan	to write something for somebody	*insurátan*
maisurátan	something is written for him	*naisurátan*
paisurátan	to order something to be written for somebody	*pinaisurátan*
mapaisurátan	something is ordered to be written for him	*napaisurátan*
etc.	etc.	etc.

9. PREFIX *IPA*

ipasúrat	to give something to be written	*inpasúrat*
mañgipasúrat	he gives something to be written	*nañgipasúrat*
manañgipasúrat	he gives many things to be written	
pañgipasúrat	something with which to give something to be written	*pinañgipasúrat*
pañgipasurátan	where, why, to whom one gives something to be written	*nañgipasurátan*
panañgipasúrat	how, when one gives something to be written	
panañgipasurátan	giving something to be written	
pañgipasuráten	to order somebody to give something to be written	*pinañgipasúrat*
mañgpañgipasúrat	he orders somebody to give something to be written	*nañgpañgipasúrat*
mamañgipasúrat	do.	*namañgipasúrat*
manañgpañgipasúrat	he often orders somebody to give something to be written	
manamañgipasúrat	do.	
mammañgipasúrat	do.	

pan͠gpan͠gipasúrat	something to order somebody to give something to be written	*pinan͠gpan͠gipasúrat*
paman͠gipasúrat	do.	*pinaman͠gipasúrat*
pan͠gpan͠gipasurátan	where, why, to whom one orders somebody to give something to be written	*nan͠gpan͠gipasurátan*
paman͠gipasurátan	do.	*naman͠gipasurátan*
panan͠gpan͠gipasúrat	how, when one orders somebody to give something to be written	
panaman͠gipasúrat	do.	
pamman͠gipasúrat	do.	
panan͠gpan͠gipasurátan	ordering somebody to give something to be written	
panaman͠gipasurátan	do.	
pamman͠gipasurátan	do.	
pan͠gpan͠gipasuráten	to order somebody to order another to give something to be written	*pinan͠gpan͠gipasúrat*
paman͠gipasuráten	do.	*pinaman͠gipasúrat*
mapan͠gipasúrat	he is ordered to give something to be written	*napan͠gipasúrat*
maipasúrat	it is given to be written	*naipasúrat*
paipasúrat	to order something to be written	*pinaipasúrat*
man͠gpaipasúrat	he orders something to be given to be written	*nan͠gpaipasúrat*
mamaipasúrat	do.	*namaipasúrat*
manan͠gpaipasúrat	he often orders something to be given to be written	
manamaipasúrat	do.	
mammaipasúrat	do.	
pan͠gpaipasúrat	something with which to order something to be given to be written	*pinan͠gpaipasúrat*
pamaipasúrat	do.	*pinamaipasúrat*
pan͠gpaipasurátan	where, why, to whom one orders something to be given to be written	*nan͠gpaipasurátan*
pamaipasurátan	do.	*namaipasurátan*

panañgpaipasúrat	how, when one orders something to be given to be written	
panamaipasúrat	do.	
pammaipasúrat	do.	
panañgpaipasurátan	ordering something to be given to be written	
panamaipasurátan	do.	
pammaipasurátan	do.	
pañgpaipasuráten	to order somebody to order something to be given to be written	*pinañgpaipasúrat*
pamaipasuráten	do.	*pinamaipasúrat*
mapaipasúrat	it is ordered to be given to be written	*napaipasúrat*
etc.	etc.	etc.

BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

REVIEWS

Dictionary of Geological Terms (exclusive of stratigraphic formations and paleontologic genera and species). By C. M. Rice. Ann Arbor, Michigan, Edwards Brothers, Inc., 1940. 461 pp. Price, $6.

This dictionary is a very complete compilation of geological terminology and contains about 15,000 terms. Each term is followed by a brief definition which has been extracted from a previous compilation on the word of a recognized authority, or which has been "edited and approved by that member of the Princeton Department of Geology in whose field the term lies." Reference to the former compilation or the authority quoted is given in parenthesis following the definition. The lack of reference to either the original definition or a recognized authority is a disadvantage to a reader desiring a more complete discussion. In some cases there seems to be an unnecessary disregard of controversial meanings.

In spite of these deficiencies, however, the book will be a worthwhile addition to the library of a geologist or a mining engineer as well as to a scientific library, for it is convenient to use and gives definitions of geological terms in a readily understandable form.—R. W. M.

Periodic Health Examination; a Manual for Physicians. 2d rev. ed. By the American Medical Association. Chicago, The Association, 1940. 104 pp., illus. Price, $0.25.

This pamphlet is a useful guide to the preservation of health and the amelioration of disease; namely, by the periodic medical examination of healthy or apparently healthy people, including prenatal as well as postnatal examination at all ages. Formerly the physician's attention was largely confined to examination of the sick and the application of appropriate remedies; now it is no less important task of forestalling sickness and suffering by examination of those who are well and advice against unhealthy habits and unhygienic modes of living. People should be advised that a periodic overhauling of the human machine is necessary for the preservation of health.—W. V.

Cancer, a Handbook for Physicians. Prepared by the Tumor Committee of the Connecticut State Medical Society. Hartford, The Connecticut State Department of Health, 1939. 193 pp., illus.

This little book is a handy reference for every physician. Although some books discuss cancer in a more detailed fashion, it is worthwhile for a practitioner to be able to get hold of one like this—concise yet informative. The State Tumor Committee of Connnecticut has done a great service in publishing this book. —P. S. C.

Social and Biological Aspects of Mental Diseases. By Benjamin Malzberg. Utica, New York, State Hospitals Press, 1940. 360 pp. Price, $2.50.

Numerous years of experience make Benjamin Malzberg, Ph. D., a capable researcher in the field of mental diseases. The present book is the result of the author's unprecedented and untiring effort in ransacking the noted libraries of psychiatric and mental clinics. It is well written and contains numerous tabulations. It will serve as a guide for students in the field of psychiatry. With its statistical tabulations it should facilitate a comparative and comprehensive study of the mental diseases as described in each chapter.—F. S. S. M.

Profitable Poultry Keeping. By H. Clyde Knandel. New York, Orange Judd Publishing Company, Inc., 1940. 462 pp., illus. Price, $3.

"Profitable Poultry Keeping," written by H. Clyde Knandel, Professor and Head of the Poultry Department of the Pennsylvania State College, is a fundamentally sound and practical text for beginners, vocational school pupils, college students in need of an elementary text in poultry husbandry, and farmers and commercial poultry raisers with practical poultry-keeping problems. The book was written to meet actual needs and to render the greatest possible service to all who are contemplating a study of poultry husbandry.

The style of the book offers four clear-cut educational advantages. At the beginning of each chapter several keynote questions are presented for the purpose of emphasizing the major objectives covered by the chapter. Each chapter is followed by discussion topics, laboratory projects, and further reading references which serve as teaching aids to the instructor and learning aids to the pupil and the general reader. Numerous topics and projects are offered, so that the teacher may choose those that best meet local conditions. Carefully selected references, for those who desire more information on any specific topic, are appended to each chapter. In addition, many helpful sources of other information, including a complete list of the standard classes, breeds, and varieties of poultry and the average percentage of commonly used poultry feeds, are given in the appendix. The book as a whole attempts to bring together in a brief and systematic fashion present-day knowledge of the problems encountered in poultry husbandry.

The author starts with a discussion, in Chapter I, of the importance, development, and exceptional vocational opportunities that poultry keeping offers. Step by step the science and art of poultry keeping are discussed, from the egg and its incubation in Chapter III, to the marketing and disposal of the final product.

In poultry, as well as in all branches of productive agriculture, better strains and breeds are now produced. This improvement is attributed to two major factors (1) environment and (2) improved breeding methods. The former includes feeds and feeding management, which are discussed in chapters V, VI, VII, and VIII, and housing, discussed in chapters IX, X, and XI. Problems and methods in poultry breeding including the fundamental laws involved are discussed in chapters XIII and XIV.

The biggest problem facing the poultry industry today is the high annual mortality caused by diseases and parasites. The failure of a poultry farm is almost invariably due to the ravages of disease and parasites of some kind. Chapter XVI deals with the common diseases and parasites, and includes a plan for disease prevention.

The author closes his book with a discussion on the different factors that may affect the poultryman's profit. As in any other business, personal attention plays a very important rôle in the successful operation of a poultry farm.

The text is well illustrated throughout with photographs of high instructional value, carefully chosen diagrams, charts, and tables.—R. G. M.

The Milking Goat; a Practical Hand-Book for the Novice, as well as a Book of Reference for the Seasoned Goat Dairyman. By M. R. Steffen. Vincennes, Indiana, W. L. Tewalt, 1940. 69 pp. Price, $1.

This little book, besides being easy to understand by the laity, contains worthwhile and practical information on the goat as a milk producer. At the beginning, however, the author is a little too anxious to give views that require proof. He mentions "an unknown factor in milk wholly divorced of our understanding of nutrition, etc., states that cow's milk is "rather crudely emulsified," and that "milk not fit to drink raw is not fit to drink at all." Canned and powdered milk are certainly wholesome and the most convenient form where fresh milk is not available. While this work is intended to give helpful hints to beginners, it is, nevertheless, a handy and useful reference for every farmer and every seasoned dairyman.—C. X. B.

Basket Pioneering: a Popular Hand-Book Containing Concise Basketry Directions with Clear Simple Diagrams—Designed for the Beginner as Well as the More Experienced Basket Weaver. By Osma Palmer Couch. Rev. ed. New York, Orange Judd Publishing Company, Inc., 1940. 163 pp., illus. Price, $1.75.

The book gives, in lesson form, various methods for making different kinds of baskets. Each lesson states the materials to be used, and the steps in making a basket, part by part, or in manipulating every kind of special material that is to be used.

That the processes involved in shaping the material are easy is evidenced by the fact that the materials are round, like vines, willow rods, and reeds, which require only a very few hand tools —the bolo or knife being the most important. Because of the abundance of materials for basket making in our forests, the art herein described should give rise to household industries and thus contribute much towards providing a means of livelihood to many who live near forests. The book is highly recommended as an addition to every school library, especially to every industrial school library.—C. P.

Money Making Formulas. Edited by C. A. Crowley. Chicago, Illinois. Popular Mechanics Press, 1939. 480 pp. Price, $4.35.

The title of this book is indeed attractive, and unlike similar publications, the book is more than a mere collection of formulas. It opens with a discussion of developing and marketing a new product. It tells how to use formulas, test them, and make improvements upon them. It also explains in a simple manner the various experimental methods, such as weighing, measuring, volume, grinding, mixing, making solutions, heating, filtration, distillation, compounding, and how to make emulsions, which are ordinarily encountered in an experimenter's laboratory. The main body of the book follows. It consists of twenty-five chapters devoted to discussions, methods of manufacture, and formulas of various kinds of commercial products, such as soaps, polishes, glues, paints, varnishes, cosmetics, food products, and pharmaceutical products. Each of these chapters is preceded by a very simple, nontechnical discussion of the characteristics and requisites of a particular class of products, like polishes, for example. The functions of the principal ingredients used in a certain formula and the methods of treating them to bring about the desired results are also discussed in some detail. References to more detailed or additional manufacturing information are found at the end of each chapter.

If one of the aims of this book is to acquaint "young chemists who, after leaving the university, are faced with the problem of finding out precisely what a chemist does to earn his pay," this aim is achieved in a large measure. To the experienced chemist entering a new industry this book will also be of great interest.—I. P.

Be Your Own Gardener. How to Make, Maintain and Find Satisfaction in Intimate Flower Gardens. By Sterling Patterson. New York and London, Harper & Brothers, 1940. 370 pp., illus. Price, $2.50.

This book, with its beautiful photographic illustrations and a glossary of garden terms, is intended primarily as a "guide, philosopher and friend" to hundred of thousands of Americans who cherish the art of garden making on a small scale. The author presents his subject matter in the simplest manner possible, based mostly on the application of tested principles and on his personal experience as to the fashioning and maintenance of flower gardens. The arts of designing a garden, fertilizing the soil, caring for lawns, and treating different garden species as to their requirements and arrangements, are given extensively. Although this book was written primarily to suit American conditions and tastes, many of the principles discussed can be applied in the Tropics, where many of the species mentioned can be satisfactorily grown and many naturalized ones can be substituted with the least trouble. Thus this book not only provides wholesome reading matter for garden-minded individuals to broaden their horizon in the art of gardening, but also serves as a guide to them in starting their own gardens.—J. B. J.

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EXPERIMENTAL STUDIES OF DENGUE. By James Stevens Simmons, Joe H. St. John, and Francois H. K. Reynolds. Order No. 489. Bureau of Science Monograph 29. Paper, 489 pages, 8 plates, and 159 text figures. Price, $3.50 United States currency, postpaid.

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